# The Australian and New Zealand Journal of Surgery

**MARCH, 1932.**

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# EDITORIAL NOTICES.

EDITORIAL communications should be addressed to the Editor, The Printing House, Seamer Street, Glebe, New South Wales. If preferred, original articles may be sent to the Chairman or to any member of the Editorial Committee. It is understood that original articles forwarded for publication are offered to THE AUSTRALIAN AND NEW ZEALAND JOURNAL OF SURGERY alone, unless the contrary be stated.

All articles must be typewritten and double or treble spacing should be used. Each article should conclude with a brief summary and statement of conclusions. Authors are requested to avoid the use of abbreviations and not to underline either words or phrases.

When illustrations are required, good photographic prints on glossy gaslight paper should be submitted. Line drawings, charts, graphs and so forth should be drawn on thick white paper in India ink. Authors who are not accustomed to prepare drawings of this kind, are invited to seek the advice of the Editor if they are in any doubt as to the correct procedure. Skiagrams can be reproduced satisfactorily only if good prints or negatives are available.

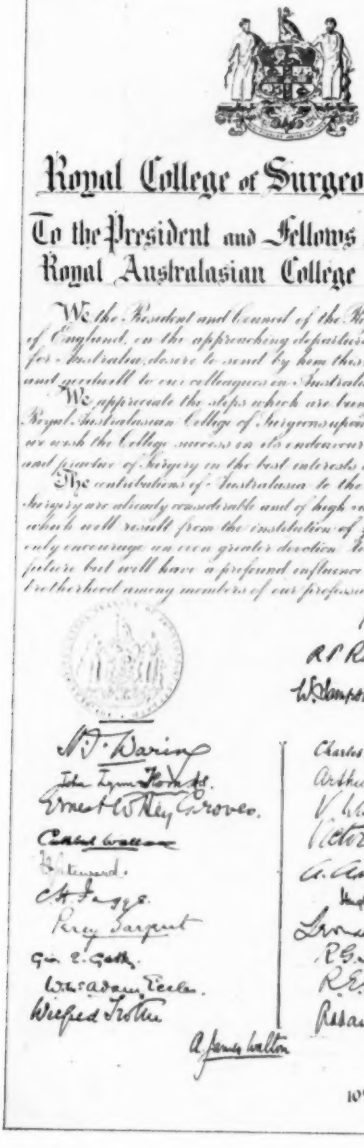
References to articles and books should be carefully checked. In a reference the following information should be given without any abbreviation: Initials of author, surname of author, full title of article, name of journal, volume, full date (month, date and year), number of the first page of the article. If a reference is made to an abstract of a paper, the name of the original journal together with that of the journal in which the abstract has appeared, should be given with full date in each instance.

Reprints can be supplied at cost price; the minimum number is fifty copies. Orders for reprints must be given when the proof is returned.

Business communications should be addressed to MR. H. B. DEVINE, 57 Collins Street, Melbourne. Remittances should be made payable to the Royal Australasian College of Surgeons.

Communications regarding subscriptions and advertisements should be addressed to W. Watson and Sons, Ltd., Watson House, Bligh Street, Sydney.

The Mace Presented by the Members of the Council of the Royal College of Surgeons of England to the Royal Australasian College of Surgeons.



Royal College of Surgeons of England.

To the President and Fellows of the
Royal Australasian College of Surgeons.

We the President and Council of the Royal College of Surgeons of England, on the approaching departure of Mr C. H. Fagge for Australia, desire to send by him this message of sympathy and goodwill to our colleagues in Australasia.

We appreciate the steps which are being taken to place the Royal Australasian College of Surgeons upon a firm foundation and we wish the College success in its endeavour to promote the study and practice of Surgery in the best interests of the community.

The contributions of Australasia to the Science and Art of Surgery are already considerable and of high value. The new inspiration which will result from the institution of your College will not only encourage an even greater devotion to our cause in the future but will have a profound influence in fostering a sense of Brotherhood among members of our profession.

Moynihan — President

R. P. Rowlands
W. Hampson Handley — Vice-Presidents

N. J. Davies
John Lynn Thomas
Ernest W. Hey Groves.
Charles Wallace
Edmund Owen
C. H. Fagge
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Robert Milne

A. James Walton

10th December, 1931.

Facsimile of the Message sent by the Council of the Royal College of Surgeons of England.

# Presentation of the Mace.

**Mr. C. H. Fagge, sometime Vice-President of the Royal College of Surgeons of England, in presenting the mace to the Royal Australasian College of Surgeons, said:**

Mr. President: In the name and by the authority of the Council of the Royal College of Surgeons of England, I ask you, on behalf of the Fellows of the Royal Australasian College of Surgeons, to accept this mace which my colleagues hope may remain throughout the existence of our two Colleges an emblem of the brotherly affection which binds us together.

A mace was in early days a weapon of offence, but in the twelfth century ceremonial maces, originally intended for the protection of the King's person, came into use. At first the flanged end of the mace, that is, the head of the war mace, was borne uppermost and the small button bearing the Royal Arms in the base, but by the fifteenth century the position was reversed owing to the greater importance of the end which bore the Royal Arms; gradually this end of the mace has completely eclipsed the "heel" as the beauty and elaboration of its decoration increased.

In the year 1822 a mace was granted to our College by the munificence of our most august Sovereign King George IV; this was some thirteen years before the first settlers erected on the banks of the Yarra those turf huts which, under the name of Dootigala, were destined to provide the earliest traditions of this great and beautiful city.

In our charter of that year which was supplementary to our first charter of 1800, it is set out that "it is Our further will and pleasure that it shall and may be lawful to and for the said College at all times hereafter, and upon all such occasions as they shall think proper and expedient, to exercise and enjoy the Right and Privilege of having a mace."

In designing this mace for the Royal Australasian College of Surgeons, Omar Ramsden has followed the general form and proportions of that of the Royal College of Surgeons of England which was executed by His Majesty's goldsmiths; of necessity the ornaments have been altered and appropriate emblems have been introduced.

By express permission of His Majesty's King George V, the finial is formed by the royal orb and cross; these emblems are supported by four arms or buttresses suggesting the form of a monarchial crown, and on them is woven a border of briar symbolizing the thorny path which leads to greatness.

The four panels around the head bear the arms of the Commonwealth of Australia, of the Dominion of New Zealand, of the Royal Australasian College of Surgeons and of the Royal College of Surgeons of England, between which are oak decorations emblematical of the permanence of the institutions just mentioned.

Beneath the head, which as is fit is supported by eight British lions, is a wavy strip to symbolize the separating seas.

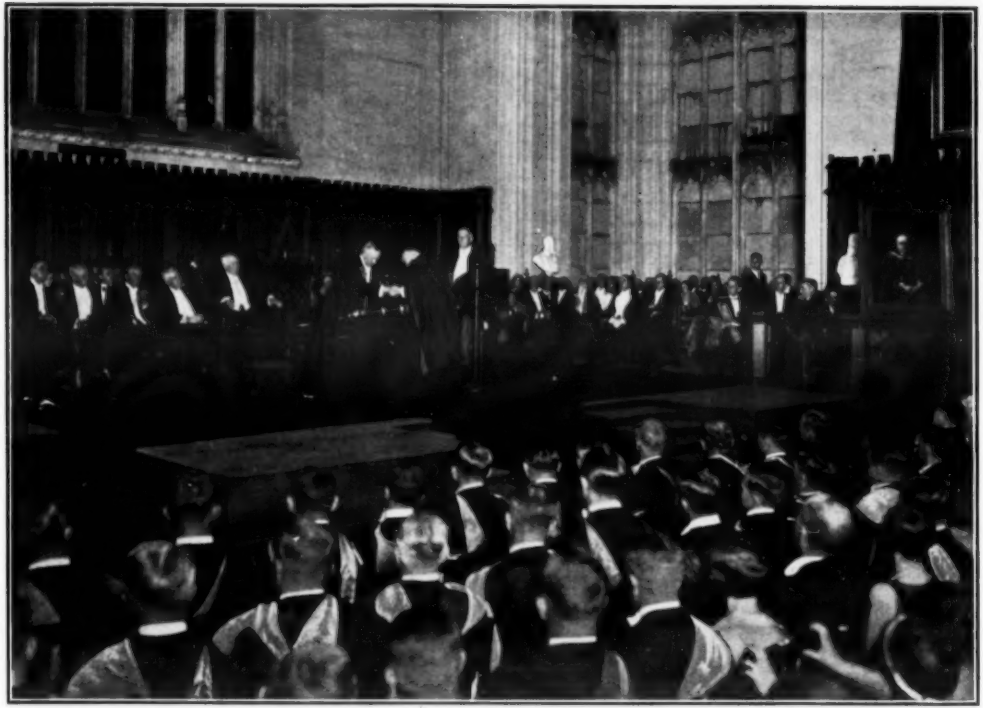
The universal decorations are the rose of England, the seven pointed star and wattle of Australia and the fern of New Zealand; and the staff bears the names of the donors—the twenty-four members of the Council of the Royal College of Surgeons of England in the year 1930-31.

The cap bears the royal arms and round this is a legend that it is the gift of our College to yours—as brothers to brothers.

And now, companion of my waking thoughts for many months, farewell. You have I watched from earliest hours when, plate of virgin silver, you gave yourself to be fashioned by the craftsman's skill. Your every spray of wattle, every frond of fern have come to life within my ken, and, gradually, once a thing inanimate, your spirit has entwined itself round mine. Today we part, but it is my hope that your new friends will ever hold you in their hearts, not only as a kingly emblem richly wrought, but as a spirit of affection which has passed from Mother Country to her sons. Stay here ever to watch their future, to guide their aims, and to bless their destiny.

**Sir Henry Newland, President of the Royal Australasian College of Surgeons, in accepting the mace, used the following words:**

Mr. Fagge, as President of the Royal Australasian College of Surgeons, I accept with pride and gratitude this most beautiful mace presented by you on behalf of the Council of the Royal College of Surgeons of England. The generous motives and the fraternal sentiments which prompted the gift have touched our hearts. We appreciate to the full the thought, the care and the skill bestowed upon its design and construction. The mace is a symbol of the trust reposed in those who, in this Commonwealth and in the Dominion of New Zealand, have in their keeping, now and ever, the good repute of surgery. This young College, looking beyond the seas for inspiration, finds it in the ideals and example of the Royal College of Surgeons of England. The College is conscious, too, that the good repute of surgery must be wounded, should the flame of science flicker, should the hand in the exercise of the art fail or falter, should the feet of its votaries stray from the path of honour. Of these three, the science, the art and the honour of surgery, this mace is an emblem cast in noble mould. In pledging ourselves to cherish it, may our vision of its beauty ever strengthen our purpose to adhere to all its symbolizes.



Ceremony of the presentation of the mace in the Wilson Hall of the University of Melbourne in the presence of the Lieutenant-Governor of Victoria and the Chancellor of the University of Melbourne.

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THE AUSTRALIAN AND NEW ZEALAND JOURNAL OF SURGERY

Registered at the General Post Office, Melbourne, for transmission by post as a periodical.

VOL. I. MARCH, 1932. No. 4.

# FIBROCYSTIC EPITHELIOMATA OF THE JAW.

By HAROLD DEW AND DOUGLAS MILLER.

[*From the Department of Surgery, University of Sydney.*]

THOUGH of comparatively rare occurrence, fibrocystic disease of the jaw presents problems of considerable pathological and clinical interest.

These tumours had been recognized, surgically removed and exhibited in museums for many years predating both their clinical and their pathological differentiation from other types of cystic tumours of the jaw. Following upon investigations of their pathology and histogenesis by many workers, they have been so variously named that the nomenclature now applied to this single clinical entity is at once confusing and unsatisfactory. The recent occurrence of two cases of this disease in our hospital practices has led us to review the literature, to make some suggestions as to nomenclature and to express an opinion as to the proper surgical treatment.

## HISTORICAL.

A very early record of this lesion is to be found in the Dublin Hospital Reports of 1826 by Cusack.[1] In 1855 James Syme,[2] in a clinical lecture in which he recorded his observations on cystic tumours of the jaw, emphasized the fact that curettage and packing of the cyst was usually effective treatment in those cases in which a tooth was found in the cystic cavity. In other types, which we now realize have an entirely different pathology, he did not find simple curettage to be effective. This appears to be the first occasion on which a clinical differentiation between these epithelial tumours and dentigerous cyst or follicular odontome was made.

In 1872 we find an account of their histo-pathology given by Christopher Heath. He recorded a case in which the tumour was eighteen inches in circumference and described the histological picture as showing a fibrous stroma, with multiple cystic spaces, lined by cells of an

epithelial type, but "lacking the distinct cell and nucleus of epithelium." In 1877 Magitot,[3] following the accepted pathological views of his time, classified these tumours on the assumption that they were derived from dilated dental follicles.

In 1879 a very valuable contribution was made by Falkson.[4] He emphasized the epithelial nature of the reported tumours, and postulated their histogenetic relationship to the dental enamel organ. In his account he described columnar cells and stellate cells which closely resembled those of this organ. In 1881 Bryck[5] reported a case occurring in a child and supported Falkson's views that this tumour originates in the enamel organ.

In 1883 Eve,[6] in an address at the Royal College of Surgeons, contributed a very careful study of the problem, based on his investigations of several specimens. He strongly contested the use of the term "simple multilocular cystic disease," and produced ample histological evidence in support of the relative malignancy of these tumours. He advanced the view that they did not arise from the enamel organ itself as maintained by Falkson, but from downgrowths of enameloblastic epithelium from the surface of the gum. He pointed out that in his opinion there was usually no interference with normal dentition, and also that all grades and stages of tooth development may be represented in an individual tumour. Some of his sections showed epithelial downgrowths continuous with the epithelium of the gum on the one hand, and with the main mass of the tumour on the other. He also put forward the argument that, as the usual time of development was in mid-adult life, they were probably not derived from embryonic rests. He proposed that the lesion should be named "multilocular cystic epithelial tumour."

In 1885 Malassez[7] wrote a paper which is now a classic, in *Archives de Physiologie* on "*Le Débris épithéliaux paradentaires.*" This paper has come to be accepted as the basis for many of our conceptions of the nature of pathological processes originating in connexion with the teeth. He described a chain of epithelial *débris* around the fœtal tooth, extending from crown to apex, and produced evidence in support of his view that multilocular cystic tumours arose from these epithelial remnants of the dental organ. He proposed the name "adamantine epithelioma."

In 1894 Heath, in his "Injuries and Disease of the Jaw," subscribed to Malassez's view, ascribing all dental and dentigerous cysts to an abnormal growth of paradental epithelial rudiments.

Bland Sutton,[8] in "Tumours, Innocent and Malignant," in 1906 classed the multilocular tumours as "epithelial odontomes," but put forward the view that a large number of the cases reported were in reality endotheliomata of gingival origin. Bland Sutton was greatly influenced by the argument that tumours supposed to arise from paradental *débris* should show signs of activity earlier in life than these tumours usually do. This argument, however, does not appear to apply to other cysts arising from embryonic inclusions, and also numerous cases

of this condition occurring in children are on record. The endothelioma theory has never gained many adherents, and is not now even held by its original proposer; he has in 1922 stated that many of them occurring after middle life are really carcinomata.

Galippe[9] in 1895 carefully reviewed the whole subject, tracing in fuller detail the probable relationship of paradental epithelial rudiments to these tumours. Since then many papers dealing with their pathological and clinical nature have appeared in the literature, among them those of Bloodgood,[10] Murphy,[11] Wohl[12] and Bump[13] may be specially mentioned. Most of these writers agree with Malassez as to the derivation of these tumours, and the term adamantine epithelioma or adamantinoma is now almost universally adopted, especially in France and America. In Great Britain the clinical terms fibrocystic disease of the jaw, cystic epithelial tumour and epithelial odontome are still, however, often used.

## CLINICAL HISTORIES.

CASE I.—C.M., a male, aged sixty-three years, was admitted under the care of H.R.D. to the Royal Prince Alfred Hospital, and gave the following history.

A swelling in the right lower jaw was first noticed eighteen years previously. A year later he had a "cyst" removed from the jaw and there was no further trouble until fourteen years later (three years before admission), when the swelling reappeared in the same place and gradually increased in size. Though at first painless, it later became associated with some neuralgia.

FIGURE I. Photograph of Patient Number 1, showing extent and site of the swelling of the lower jaw.

On examination three years ago at another hospital there was a large cystic swelling in the region of the angle of the right mandible and at the level of the last molar tooth a sinus discharging yellow pus. A radiograph on February 7, 1929, showed complete destruction of the cortex about the angle of the right mandible, an appearance suggesting "myeloid sarcoma."

On February 18, 1929, the swelling was opened by an incision near the angle of the mandible, curetted and drained. At first the drainage was profuse, but it rapidly lessened. When seen on August 28, 1929, the sinus was still discharging slightly. It was again curetted and some necrotic bone removed. Following this the discharge gradually lessened, the sinus closed, but the cystic swelling recurred and, in spite of some intermittent discharge, grew persistently until it reached a very large size.

When seen on June 10, 1931, there was a very large cystic swelling on the right side, occupying the whole region of the lower jaw from within 1·25 centimetres (half an inch) of the mid-line to well above the angle. It also extended as far as the malar bone cranially and caudally involved the anterior triangle of the neck, overhanging the structures here as far as the level of the cricoid cartilage. It also extended medially under the mucous membrane of the floor of the mouth and well under the tongue. In this situation it was covered solely by a thin layer of mucous membrane, and one of the remaining teeth in the upper jaw had caused a small superficial ulceration. There was no limitation of the

movement of the tongue and but little limitation of jaw movement. On the external surface there were three scars of previous operations, while near the centre of the swelling was a cystic projection, bluish in colour, over which the skin was of the thickness of tissue paper. This was the site of previous intermittent discharge, and so thin was the covering here that it seemed that a fresh discharge might occur at any time (Figure I). Around the same area were some well marked capillary telangiectases, while the whole area was somewhat pigmented. On palpation the swelling was cystic and seemed to be thin walled and multilocular,

FIGURE II. Radiograph, Case I, showing expansion and destruction of the bone of the lower jaw, with, however, some persistent bony trabeculæ. (From Radiographic Department, Royal Prince Alfred Hospital.)

while in several places, at the angle and inferiorly particularly, bony trabeculæ could be felt. There was no evidence of inflammation, nor was the lesion at all tender. All of the teeth were missing from the lower jaw on this side, and the patient stated that most of these had been removed many years before.

A radiograph on June 12, 1931, showed much destruction of the lower jaw by multiple cysts with great expansion, but with some bony trabeculæ present.

*Operation.*—Under ether anæsthesia induced by the intratracheal method, the external carotid artery was exposed under cover of the overhanging tumour at the level of the hyoid bone, and ligated. The lower lip was then split in the mid-line

and a skin incision made from the front of the chin to the ear, enclosing an elliptical piece of skin containing the old scar and the adherent projecting cystic area. The flaps were then reflected and the jaw divided near the mid-line, and the mucous membrane of the mouth divided in a similar way to the skin, an ellipse of mucosa over the area being removed where it seemed densely adherent to the cyst. The attachment of the muscles in the floor of the mouth was then divided and the submaxillary structures dissected free. After separation of the masseter muscle the temporal muscle tendon was divided close to the coronoid process, which was entirely replaced by cystic growth. In attempting to free the condyle intact the cystic mass with capsule came away from the bone, which fractured, leaving the hollowed out condyle in place. This was, however, removed separately, some hæmorrhage from the internal maxillary artery, which had been displaced upward, making it necessary to leave an artery forceps on. The floor of the mouth was reconstituted and the skin incision closed, the forceps acting as a drain in the region of the angle. Convalescence was uneventful.

FIGURE III. Photograph of Patient Number I three months after operation.

The patient when seen at the end of three months showed remarkably little deformity following the removal of so large a tumour (see Figure III).

CASE II.—A female patient, aged fifty-three years, was admitted to Saint Vincent's Hospital, under the care of D.M., and gave the following history:

At the age of eighteen years a swelling appeared in the submaxillary region beneath the right side of her mandible. She states that, though it increased rapidly in size for eighteen months, it was painless. There were no teeth missing, nor had there been any sepsis or trauma affecting the jaw. A local operation was performed from the outer aspect, and this resulted in the disappearance of the tumour. There was no further trouble until four years ago, when a swelling again developed in the right submaxillary region and attained a considerable size. From her description this tumour seems to have been soft and fluctuant. It was again removed by a local operation, being approached from the submaxillary region. Eight months after operation the tumour again reappeared, and rapidly increased in size, latterly being associated with a considerable amount of neuralgic pain.

FIGURE IV. Photograph of Patient Number II, showing extent and position of the cystic tumour.

On examination there was very marked swelling of the face extending cranially to just below the malar region and inferiorly almost as far as the canine fossa of the lower jaw. The tumour also extended into the submaxillary triangle, while posteriorly there was a large rounded swelling in the region of the angle of the mandible (see Figure IV).

The tumour was thin walled and felt tensely cystic, the intrabuccal extension pushing medially beneath the mucous membrane of the floor of the mouth, which was tensely stretched over it, and had a "blue domed" appearance. The extension into the submaxillary triangle was globular, the size of a hen egg, and adherent to the old operation scar.

A small piece of bone could be palpated in the region of the angle, and above this the cystic dilatation of the jaw reached its greatest development. The movements of the jaw were considerably restricted, but no other abnormality was detected. A radiograph showed almost complete destruction of the right side of the body and ascending ramus of the mandible by large thin walled cysts. A

FIGURE V. Radiograph, Case II, showing destruction of the lower jaw by the tumour. (From Radiographic Department of Saint Vincent's Hospital, Sydney.)

small strut of bone was apparent at the posterior margin of the junction of the ascending ramus and the body, while the coronoid and condyloid processes appeared to have been completely destroyed.

*Operation.*—Under ether anæsthesia induced by the intratracheal method, a two-way tube being introduced into the trachea, the pharynx was packed with gauze, and at the level of the hyoid bone a small incision made over the external carotid artery, which was ligated immediately above the origin of the superior thyreoid artery. This incision was then closed. A second incision was made from the mid-line of the lower lip to the mid-line of chin, and then bifurcated to include a portion of tumour adherent to the old scar, and carried up to the level of the mastoid process. The full thickness of the lip was divided and the entire flaps reflected. The mandible was then sectioned close to the mid-line on the affected side, and the mucous membrane inside the mouth divided along its reflection on to the mandible. The muscles of the floor of the mouth were then

sectioned. Owing to the gross cystic expansion of the coronoid process and the extreme fragility of the jaw, considerable difficulty was experienced in separating the insertion of the temporal muscle, and later of the external pterygoid. During these manipulations the main cystic mass broke away within its capsule from the shell of the condyloid process, which was then easily removed separately. The inferior alveolar nerves and vessels were found to be considerably frayed out over the tumour. Slight but easily controlled hæmorrhage from the internal maxillary artery was encountered.

The mucous membrane was then sutured, the floor of the mouth being restored. The skin was sutured and a small drain left in the wound. The patient made an uninterrupted recovery, and was discharged from hospital in ten days. The patient was seen again after three months, and showed remarkably little deformity (see Figure VI).

FIGURE VI. Photograph of Patient Number II three months after operation, showing relatively little deformity.

## PATHOLOGY.

All observers are agreed that these multilocular cystic tumours arise from some part of the dental germinal mechanism, and it is therefore of interest to review shortly the early stages of dental development.

### Developmental Anatomy.

The earliest stage in the development of a tooth consists of the demarcation of a ridge of epithelium from that covering the gum. The deeper portion of this grows down into the primitive jaw. This downgrowth, continuous along the whole length of the gum, is known as the dental lamina or tooth band. From this tooth band an extension projects somewhat horizontally, and is known as the dental shelf. This is completed by the seventh week of intrauterine life. The next stage is the appearance of a series of indentations in the dental shelf, causing the formation of a series of small inverted cups. These are known as the enamel organs and their development is completed by the tenth week (see Figure VII).

Projecting into the hollow of the cups a process of well vascularized connective tissue is developed; this later becomes the dental pulp (see Figure VIII).

#### *Formation of Dentine and Enamel.*

The deepest cells of the epithelium of the downgrowths now become elongated and columnar, while the more superficial cells become star-shaped, forming what is called the pulp of the enamel organ. These cells have small deep staining nuclei, while the cytoplasm is scanty and extends out in five or six long thin processes which interlace with those of neighbouring cells. The layer of columnar cells is the enameloblastic layer. The most superficial cells of the dental papilla at the same time

become differentiated as columnar cells and lay down dentine along the zone separating them from the enameloblasts. As the dentine is deposited, its upper surface is covered with enamel by the upper layer.

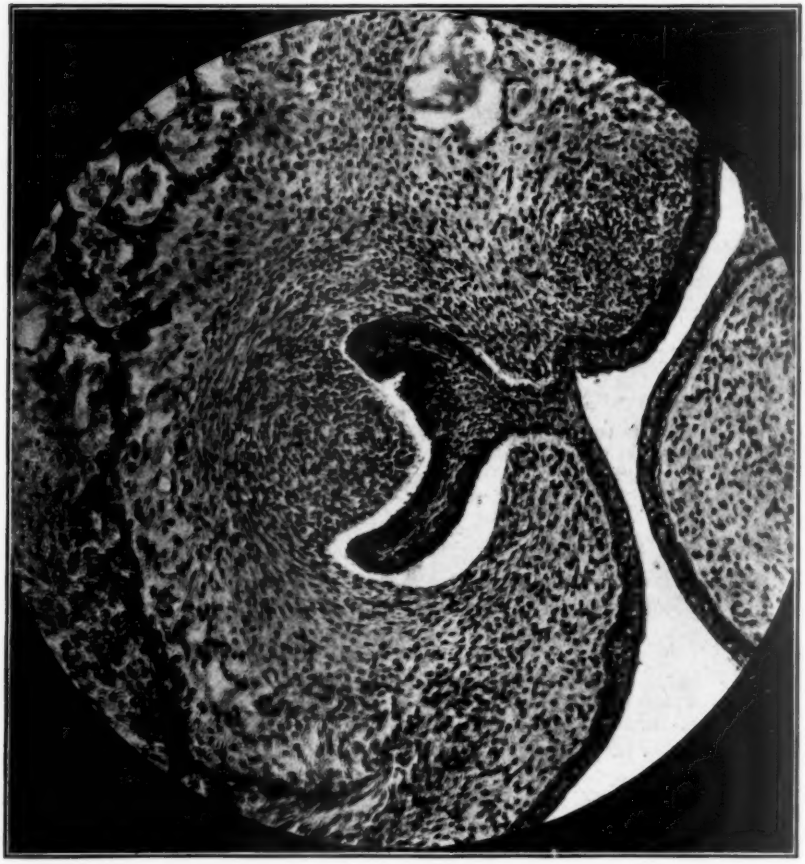

FIGURE VII. Microphotograph showing a very early stage of formation of the enamel organ.

Whether the enamel and dentine are the products of cell secretion or of cellular degeneration and transformation is uncertain. Tomes[14] observed fibrillary processes spreading out from the deep layer of cells to the recently formed enamel and concluded that calcification took place around these. By the fourth month of fœtal life the tooth is readily recognizable and the remainder of the enamel organ atrophies, being

represented only by occasional epithelial *débris*. It is thus a striking picture of temporary epithelial activity, and the surprising feature is that after all only the thin layer of enamel on the tooth is of epithelial origin.

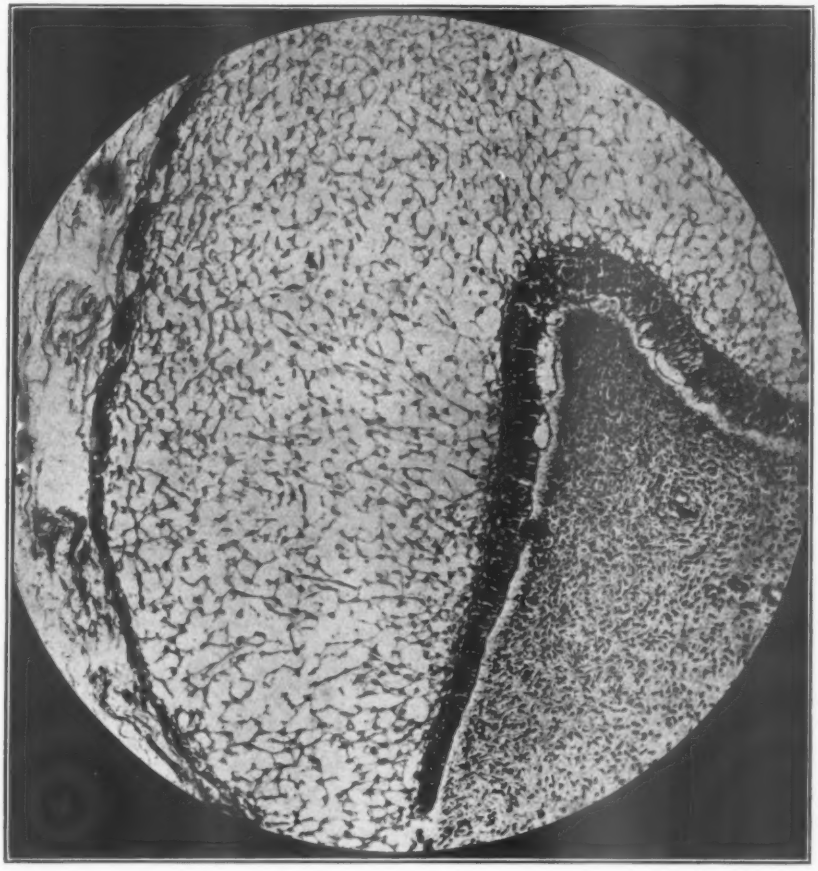

FIGURE VIII. Microphotograph showing the deposition of enamel and stellate cells of the pulp of the enamel organ.

The reaction in the connective tissue of the jaw consists of a condensation and vascularization of the cells surrounding the tooth germ and this ultimately forms the tooth sac or follicle. The tooth germ rests on the floor of this sac, which completely shuts it off from surrounding structures, the whole arrangement being comparable to the shell and kernel of a nut.

We owe to Malassez[15] a detailed account of the cells of the paradental *débris*, which he does not regard as accidental, but as analogous to the dental apparatus of lower vertebrates for the supply of supernumerary dentitions. He divides these cell collections into superficial,

FIGURE IX. Epithelial *débris* in the region of a developing tooth from human fœtus of four and a half months. Note some superficial *débris*, numerous epithelial rudiments around and along the tooth follicle, and the germ of the permanent tooth to the left.

or those lying directly beneath the gum; intermediate, along the sides of the tooth; and deep, those in the region of the enamel organ, and states that they may occur in connexion with either the decidual or the permanent teeth and that they may persist in adult life.

The superficial cells are mainly spherical, some of them being encircled by cylindrical cells. About the enamel organ are groups showing transitions between enameloblasts, round and stellate cells.

### Pathological Concepts.

There can be little doubt that these polycystic tumours owe their origin to the cell entities described above, but there has been considerable diversity of opinon among various investigators as to the actual part of the germinal epithelium concerned in the process. These different points of view have led to some confusion in the nomenclature. The problem that has to be decided, if possible, is whether different

FIGURE X. Specimen from Case I, after operative removal, showing skin excised with operation scars.

cellular types of the same tumour can occur, or whether there may not be a fundamental difference in their various modes of origin.

1. Falkson's view was that all these tumours arose from the enamel organ or part of it, though he concluded that it was not necessary for the whole organ to be involved.

2. Magitot's view was that multilocular cysts had multifollicular origins.

3. Eve believed that their origin was from ingrowth of epithelium from the gum and conferred on them the name "multilocular cystic epithelial tumours."

4. Malassez maintained that they all arose from the paradental *débris*, to which he first drew attention. His work was very carefully reviewed by Galippe[16] and now receives fairly general acceptance.

Ewing,[17] however, makes the very pertinent suggestion that, owing to the occurrence of such complex processes in connexion with the formation of two sets of teeth, there is abundant opportunity for abnormal overgrowth of several different structures, and that it is unlikely that a single embryonal remnant, such as the epithelial *débris* of Malassez, is responsible for all the numerous pathological and clinical types encountered in this region.

## General Pathological Characters.

### *Macroscopical Appearances.*

In their early stages these tumours typically consist of multiple small cysts with well formed bony trabeculæ separating them. At this

FIGURE XI. Specimen from Case I, with a flap turned down from the anterior wall, showing multicystic nature, size of the largest cyst, buttress of bone in the anterior portion and mural nodule on the medial wall.

stage the cystic nature of the growth is particularly apt to be missed. As they advance and particularly after surgical interference, they usually take one of two extreme courses. The more usual course is for the cystic element to predominate greatly, whilst the osseous framework becomes expanded and more or less destroyed. In both our specimens there is almost complete destruction of the bone. The numerous small cysts tend to coalesce and a few large spaces may ultimately replace the old

multilocular formation. These cysts may contain brownish fluid, mucus or inspissated fatty material, in which cholesterin is sometimes present. The walls of these cysts may be smooth or may have papillary projections of solid epithelial tissue. The other course which is occasionally observed is a transformation to a practically solid type of growth. Sometimes masses of fibrous tissue, calcified areas, or masses of bone or cementum are present.

For an account of the macroscopical pathological appearances the reader is directed to a description of a great number of specimens of this lesion in the museums of the various London hospitals, presented in a report on odontomes to the British Dental Association in 1914.[18]

FIGURE XII. Tumour from Case II, cut vertically, showing size, appearance and position of the growth. Note the area (A) where the bone is becoming involved near the symphysis, the persistence of a saddle of bone in the raised and shallow sigmoid notch (B), and the swollen coronoid process (C), here somewhat shrunken.

### *Macroscopical Appearances of the Lesions in the Two Cases Reported.*

In Case I the right half of the lower jaw was expanded by several separate cysts, the largest one of which extended from the mid-line of the tongue to the full extent of the swelling under the skin. This measured 10 centimetres in its greatest diameter, and was filled in the recent state with a thin brownish fluid which contained cholesterin crystals. The other cysts were similar and extended into the coronoid process which was completely replaced by them, the temporal tendon being inserted directly into the thin fibrous wall. The ascending ramus was also expanded and almost replaced by a cyst which extended into and hollowed out the whole of the condyle, this being represented by a thin shell of bone, so that the neck fractured on very slight traction. The cartilage of the joint was not invaded. There was a thick bar of bone acting as a strut between the body of the mandible and the angle near the caudal surface of the large cyst, a small piece also persisting near the angle and a saddle-shaped remnant at the base

of the sigmoid notch. The trabeculæ between the cysts were apparently not osseous, but dense avascular fibrous tissue (see Figures X and XI).

The walls of the cysts were mainly fibrous, but in one or two places a thin epithelial lining was found, while on the medial wall of the largest cyst there was a large, flat, somewhat honeycombed mural nodule of neoplasm. This extended in an irregular manner over the medial wall of the cyst, but did not involve the outer walls, and in its thickest portion was not more than one centimetre thick.

The tumour from Case II presented a very different appearance. Although on palpation it felt cystic, on section it was found that the greater part of the bone, including the coronoid process and ascending ramus, was greatly expanded and replaced by a soft tumour with a myxomatous appearance. The bone surrounding was very thin with here and there a persistent trabecula (see Figure XII).

The tumour showed its greatest diameter just in front of the angle, and measured four by nine centimetres. The cut surface was somewhat mottled and striated by reddish-brown areas which showed up very well against the homogeneous yellowish-green colour of the main mass. There was a small area where the bone was apparently more or less recently invaded near the area of symphysis. The growth seemed to be very soft and homogeneous and shrank a little after fixation; no truly cystic areas could be detected, although multiple serial sections were not taken. In some places around the growth the bone was completely missing, the capsule being composed of a thin layer of fibrous tissue to which the temporal muscle, for example, was directly attached. As in the previous case, a saddle-shaped portion of bone persisted at the bottom of the sigmoid notch, but the notch was, owing to the upward displacement of its base, much more shallow than usual.

### *Microscopical Structure.*

The histological picture of the epithelial components of these tumours may show all grades of cellular structure ranging from an undifferentiated type of epithelium to stratified squamous epithelial types or adult enameloblasts. These appearances led Eve and Büchtemann[19] to their erroneous conclusions that the tumours actually arose from the surface epithelium.

Malassez interpreted these appearances as due to upward growth of the tumour or as supernumerary invaginations of epithelium. Galippe took the view that adult gingival epithelium has lost all power of differentiation to enameloblasts, and therefore that the superficial cell groups arise from the superficial paradental *débris*, or the atrophic duct of the enamel organ. According to Ewing,[17] who has given a detailed account of the various appearances in the reported cases, histologically three main cellular types may be differentiated. They are: (i) Acanthoma, (ii) plexiform epithelioma, (iii) glandular adamantinoma.

(i) *Acanthoma.*—Acanthoma shows a squamous type of epithelium preponderating, but the central cells of the epithelial columns so often present usually show the asteroid structure of the cells of the central reticulum of the enamel organ. These star cells have small deeply staining round or ovoid nuclei and have a scanty cytoplasm which is continued into five or six fine processes. The processes of adjacent cells often fuse and give a reticulated appearance, which is a very characteristic cell arrangement in parts of nearly all these tumours, irrespective of the actual epithelial type.

(ii) *Plexiform Epithelioma.*—Plexiform epithelioma shows broad convoluted columns of small epithelial cells without marked squamous characteristics, occupying a matrix of cellular connective tissue. Many of the small tumours with early cyst formative tendencies are of this type.

(iii) *Glandular Adamantinoma.*—In glandular adamantinoma columnar enameloblasts predominate and may constitute the tumour in its entirety. These cells tend to assume an alveolar arrangement, and may enclose islands of reticulated cells. There is also a tendency to the formation of hyaline "pearls" and sometimes enamel and cement. Con-

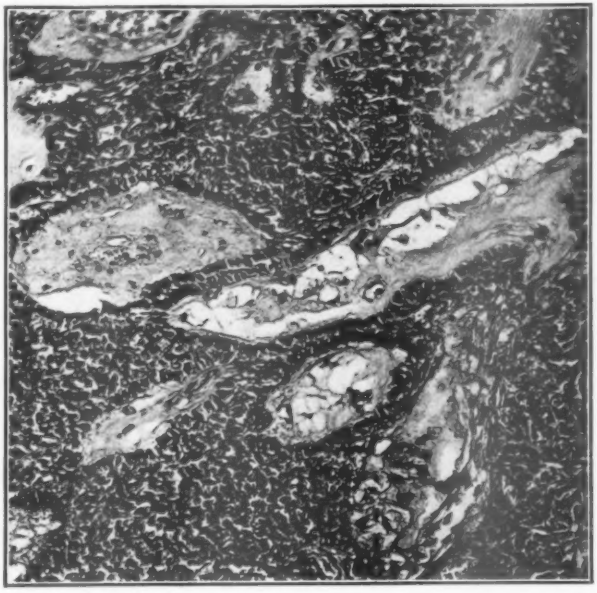

FIGURE XIII. Microphotograph of mural tumour from Case I, showing typical appearance of adamantinoma.

siderable areas of spindle cells are sometimes present, and the appearances may simulate sarcoma, but there is usually evidence of their true epithelial origin, especially at the periphery. Secretory products appear in the form of droplets of mucin which aggregate to form cystic spaces, the lining of the cyst being composed of flattened, stratified or cubical cells. Any tumour may show one or all of the above cellular appearances in varying degrees. All, however, are locally aggressive and appear to have the biological behaviour of carcinoma. Bump[13] gives some useful diagrammatic representations of the types of epithelial cells that

have been recorded. In all, a cellular connective tissue stroma is found in varying amounts and in some cases this so predominates and so overshadows the epithelial structures that the simulation of sarcoma may be accurate. Post-operative recurrences, too, tend to be associated with considerable degrees of metaplasia and anaplasia, so that the original structure of the tumours may not be recognizable. It is in these cases that appearances not unlike sarcoma or myxoma due to the preponderance of the "stroma" cells are so common.

*Microscopical Appearances of the Reported Cases.*

These two tumours are of great interest in that they represent the two extreme types of growth, but from the point of view of a histo-

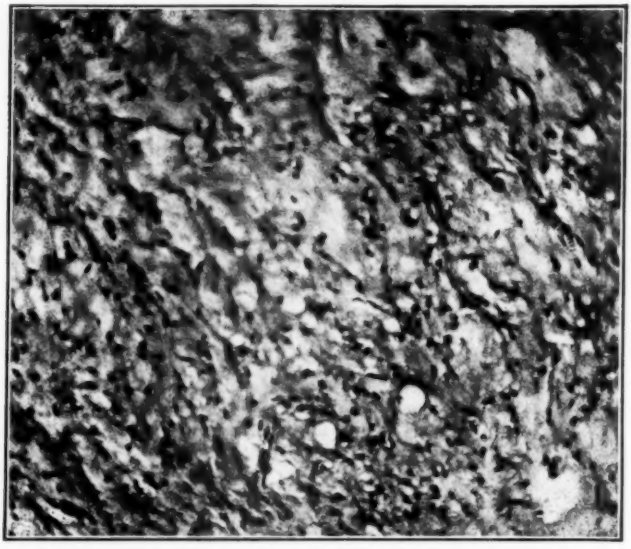

FIGURE XIV. Photomicrograph of a section of a typical area of tissue from Case II, showing myxomatous appearance.

genetic study they may be somewhat misleading owing to the frequency of gross alteration from the original cell characteristics following active recurrent growth.

In Case I sections were taken from the mural nodule and showed the typical appearance of adamantinoma with large sheets of small epithelial cells. Some of these were spindle shaped, being in places surrounded by columnar cells, which appeared to be typical enameloblasts (see Figure XIII). Here and there through the sections were islands of star cells, loosely arranged and surrounded by columnar cells, while in places mucin formation seemed to be proceeding and doubtless represented the earliest stage of cystic change. The stroma was singularly deficient and presented no features of interest or importance.

Had the tumour been examined during its early stages before the gross cystic changes or recurrence had occurred, it would possibly have shown a rather more glandular appearance.

Section of the tumour from Case II showed a totally different histological picture, and at once raised the question as to the correct diagnosis.

The gelatinous portion of the tumour showed the classical picture of myxoma. The cells were small, rounded with occasional spindle cells, stained in an irregular manner, and lay in an acellular matrix which stained well with eosin and picric acid. This stroma was abundant in parts of the tumour, in places appearing to be fibrillary, in others finely granular, while some vacuolation and blood extravasation were also present. Some of the cells were definitely stellate, having several long processes which apparently interlaced with those of other cells in the matrix (see Figure XIV).

There were many small, relatively poorly supported blood vessels in some parts of the growth, and a good deal of extravasation of red blood corpuscles towards the periphery, accounting for the reddish areas in the growth. In no sections could any transformation from any other type of cell be found, and at the edges there was a well marked encapsulation of the growth, which peeled out from the surrounding fibrous tissue very readily. This tissue was composed of layers of fibrous tissue, with laminæ of hyaline material and here and there zones of spindle celled tissue which somewhat resembled involuntary muscle or nerve tissue, but which had probably been modified by pressure effects. In many places there was no bone present at all in the capsule of the growth.

There was no tendency towards breaking down or cystic development and, in spite of the examination of many blocks of tissue, no evidence definitely proving the epithelial nature of the growth was forthcoming. Histologically the tumour was undoubtedly almost pure myxoma, but an attempt to explain its probable histogenesis at once raised some difficult problems.

## THE HISTOGENESIS OF MYXOMA.

Myxomatous tissue is not present normally in any of the tissues of the adult, so that true primary myxomata must be derived from some embryonic rudiments and such are apparently found most commonly in the form of islets of undifferentiated cells in the subcutaneous cellular tissues. Most of the true primary myxomata have been recorded in this type of tissue, and obviously must be of very rare occurrence. Secondary myxomata are much more common and are due to metaplastic change in other mesoblastic tumours, particularly lipomata, fibromata, chondromata and sarcomata, although even in these cases authorities differ in that some believe that these neoplasms are of mixed nature from the beginning. Undoubtedly in many of the mixed tumours of teratogenous origin, myxoid tissue is common and probably here represents a specific primary characteristic of some of the cells present. Ewing[20] has emphasized the fact, too, that epithelial tumours are prone to undergo mucous degeneration and that these, although practically speaking accuracy is often impossible, should be carefully differentiated from myxomata.

Another type of tumour is sometimes seen in which chronic œdema of the neoplastic tissues produces separation of the nuclei by a granular

or fibrillary ground substance, and so the formation of a pseudomyxoma —a type of tissue seen so commonly in the mucous polypus of the nose.

In the tumour under discussion the following two possibilities present themselves: (i) The tumour is a true central myxoma of bone. (ii) The tumour represents a metaplastic change in a primary embryonic epithelial tumour of the jaw.

## Myxoma of Bone.

Pure myxoma of bone is so rare that many pathological authorities do not mention it, and Bloodgood,[21] who has made a special study of it, could record only about a dozen cases. He remarks on the scantiness of reported cases in the literature of the pathology of bone, and deals at length with their clinical behaviour. He recorded cases in the humerus, tibia, astragalus, femur, vertebræ and phalanges; no case has yet been recorded in the jaw.

Myxomata in this tissue are sometimes associated with chondromata, as was first pointed out by Virchow, who also suggested that some of the central growths might be derived from the primitive connective tissue of the marrow. As recorded by Soubeyran[22] they give rise to a slow excavation of the bone, but are poorly encapsulated by fibrous tissue and tend to infiltrate their bony covering without here causing much bone destruction. There is usually some stimulation of the periosteum and new bone is often laid down at the periphery. There is a great tendency towards invasion and infiltration of the surrounding soft parts, this being almost universally the case in those tumours recurring after ineffective operations.

Some of the older observers noted the frequency of recurrence after curettage and minor operative procedures, and Bloodgood recently emphasized the quasi-malignant nature of these supposedly benign growths. He stated that he could not find a single case which remained well without recurrence after an operation consisting of curettage only, and reported several personal cases to illustrate this important fact. In some cases the recurrence in the soft parts forms a rapidly growing tumour which infiltrates widely and which may cause death by metastases. It would seem that although these recurrent tumours have the same histological appearances as classical myxoma, they should probably really be classed as myxosarcomata.

## Discussion.

In the case under discussion the advanced age of the patient, the long history, the comparatively slow growth in spite of the irritative effect of two operations, the extreme evacuation and replacement of practically all the bone, the well encapsulated nature, the lack of periosteal reaction, the absence of true bony infiltration, the large size of the lesion without any involvement of the soft parts, and the extreme rarity of the occurrence of pure myxoma of bone, particularly in this site, all

suggest the second possibility, namely, that this is an example of metaplastic secondary myxomatous change.

This view is supported by other evidence. In the common adamantinomata, as in Case I, one often finds in the middle portion of the epithelial columns a reticulated type of growth which closely resembles myxoid tissue. In the glandular types, too, similar areas of stellate cells are often seen surrounded by columnar enameloblastic cells.

As shown in Figure VIII, the cells of the pulp of the enamel organ are stellate in shape, have small nuclei and their cytoplasm is continued out into several bony strands, which interlace with those of nearby cells, producing an appearance not unlike a myxoma.

It is possible then that this lesion may be derived from epithelial cells which have almost entirely differentiated into stellate cells, and, in spite of its appearance, is epithelial in its histogenesis. It is possible, of course, that serial sections taken through the whole of this tumour would show other evidence of its epithelial origin, but in view of the fact that the common tumours in this site may be composed of cells showing all degrees of epithelial differentiation comparable to those seen in the enamel organ, there seems to be no reason why this histogenesis should not be accepted. This would obviate any necessity for any metaplastic change.

As an alternative, the tumour may be secondary myxoma produced by metaplasia of the cells of the stroma of a primary epithelial tumour, this stroma having, under the stimulus of operative interference, so developed that it has overwhelmed the epithelial elements. That this can occur with the production of cellular tumours of mesoblastic type, particularly sarcoma, is admitted by many observers, and Albarran[23] recorded a case of myxosarcomatous change in one of these tumours in 1888.

We have, then, with some diffidence it is true, finally decided so to regard this tumour, that is, that it is either an example of a primary epithelial tumour which has developed directly from epithelial precursors of the stellate cells or one in which some metaplastic myxomatous change has occurred in the overgrown connective tissue stroma.

## NOMENCLATURE.

The review of the literature and a study of these cases have served to emphasize the fact that no entirely satisfactory or uniformly accepted nomenclature has been arrived at, and we are left to choose between "multilocular epithelial tumour" of Eve, "adamantine epithelioma" of Malassez, and "epithelial odontome" of Bland Sutton.

The term "multilocular epithelial tumour" takes no account of its quasi-malignant nature, and conveys little information as to either histogenesis or structure; "epithelial odontome," too, although stating the developmental origin, does not convey an accurate pathological picture, and "adamantine epithelioma," while admitting its possible malignancy, suggests that it is always adamantine in structure, which is not the case.

It would seem that we have to recognize the fact that this tumour, like many others with an embryonic histogenesis, may assume very varied histological appearances, and that a general, non-committal term should be applied to it. Probably the term "fibrocystic epithelioma" of the jaw is open to the fewest objections, because it suggests a mixed structure, a tendency towards cystic change, an origin from epithelial cells and some degree of malignancy.

## FINAL EFFECTS.

It may be taken as a rule that these tumours do not metastasize, though Ewing[17] reported one with metastasis in the lung and in a cervical lymph gland. The nature of this tumour, however, is a little doubtful, being described as "extensive fibro-epithelial." In another of his cases the fourth recurrence was in the cervical lymph glands and loose tissues of the neck. It is probable that in these cases considerable metaplasia to a more malignant type had occurred.

Cushing[24] recorded an interesting recurrent case which, originating in the lower jaw, recurred in the pterygoid region after twelve years, causing trigeminal neuralgia from invasion of the Gasserian ganglion. Those tumours occurring in the upper jaw often invade the antrum, orbit, nasopharynx and base of the skull, and have, therefore, a much worse prognosis.

Death from tumours of the mandible is usually the result of secondary infection and septicæmia.

## CLINICAL ASPECTS.

The condition appears to be twice as common in women as in men. The average age of its appearance is the fourth decade, though cases are on record of the first signs appearing in children, James and Forbes[25] having recorded a case in a child aged four and a half years, while Coote[26] described a case in a newborn infant.

*Site.*—Of 80 cases analysed by Wohl[27] only nine were in the upper jaw, but it would seem that in this situation the tumour is more likely to be more solid and more malignant. The remainder originated in the body of the mandible, with no apparent predilection for one or other side. They may, as in the case recorded by Moore, Hadfield and Claremont,[28] invade both sides.

*Duration.*—In most of the cases recorded in the literature there was a long history, usually of many years, punctuated often by a number of worse than useless operations. Bryck recorded a case in which the tumour had been present for 26 years and Albarran one of 38 years' duration. In one of our cases the tumour had been present for 18 years and in the other for 35 years. The shortest course we can find a record of before final curative operation was one and a half years.

*Ineffectual Operations.*—In 15 cases taken at random out of the literature there was only one in which the patient had not had several

operations, and all had eventually been subjected to radical removal of the greater part of half or the entire half mandible. This constant tendency towards local recurrence after partial operation is the most outstanding clinical fact, and is an index of the truly malignant nature of the lesion and, as is the case with other types of recurrent quasi-malignant tumours, each recurrence seems to be more active than the last.

*Sepsis.*—In many cases, as, for example, in those recorded by Bump,[13] there is a history of a carious tooth and discharging socket preceding by some years the clinical appearance of the tumour. Whether the carious tooth can have any influence on the neoplastic development is difficult to say, but it is not unreasonable to suspect that the loosening and decay of the tooth are often secondary to the underlying pathological process. In many cases there is no history of tooth infection, both of our cases being normal in this respect.

*Radiography.*—The radiogram shows typical appearances with polycystic absorption and expansion of the mandible. There will be no evidence of an unerupted tooth. In the extreme degrees of development of the disease, as in our cases, the bone may be entirely absent except for a few remnants.

## DIFFERENTIAL DIAGNOSIS.

In advanced cases the diagnosis presents few difficulties, the appearances being very typical, except when metaplasia to a solid type of growth has occurred. In the early stages one would be forced to rely on radiographic help for its diagnosis from dentigerous cysts, giant cell tumours, and such rare conditions as *leontiasis ossea*.

Follicular odontome or dentigerous cyst is always associated with the absence of a tooth. It is equally common in both jaws, and the average age of appearance is fifteen years. Radiography will be conclusive by showing the large single cyst and the retained tooth enclosed within it.

Giant cell tumours commonly occur in the third decade, the incidence reaching its peak at the age of twenty-five, and the radiograph will show typical bony expansion and thinning of bone with intracystic trabeculation—appearances which are familiar to all radiologists.

## TREATMENT.

Syme in 1855 indicated how ineffectual it was to scrape and pack this type of tumour, but even at the present day it would appear that this is the usual method of treatment. It is an instructive observation that nearly all the recorded cases are those which have developed to an extreme size, and in the vast majority of these the patients have been subjected to numerous ineffectual attempts at removal. Therefore, we must conclude either that most local removals are unsuccessful, or that successful cases have not been published. Perusal of the histories of nearly all the accessible case records and of our own, tells a uniform tale

of unsuccessful surgical operation. The histological background to the picture is ample commentary on the futility of such procedures as curettage.

These tumours possess the appearances and the aggressive properties of epitheliomata of local malignancy. It is, therefore, as fundamentally unsound to subject them to trauma without complete and wide removal as it would be to do so to a basal celled carcinoma of the face. Operative treatment, therefore, must aim at complete and wide removal of the affected segment of bone.

In large tumours or after one or more recurrences, nothing short of resection of half of the mandible is likely to be of any avail. This is an operation from which many medical advisors are apt to shrink, fearing the immediate mortality and the mutilation. The patient being a good subject and the surgeon sufficiently competent, there is no reason why the mortality should be greater than the gravity of the situation warrants; as a matter of fact, it is probably under 5%. As regards mutilation, this is not a serious consideration in dealing with carcinoma, and in any case the æsthetic result is a distinct improvement on the tumour.

An endeavour should be made, however, to preserve a small portion of the mandible on the affected side of the mental tubercle, if this can be done without risk of incomplete removal, in order to preserve support for the tongue and to maintain its freedom of movement. Unless practically the whole ascending ramus can be preserved to be of possible use in fitting a prosthesis, it is better to remove it almost completely, as the muscles acting on the stump are apt to give it a tilt which is unsightly and a source of discomfort to the patient.

When the disease has followed its usual course and invaded the ramus, the condyle should be disarticulated, though if this region be healthy it will add to the ease of removal to effect division through the neck of the mandible. Where the bone is soft and absorbed the leverage necessary to bring the coronoid down for division of the *temporalis* muscle may be difficult to obtain, but it is usually possible to make a dissection around the tumour. In both our cases extreme destruction of bone in the region of the coronoid and condyloid processes led to fracture of the latter during removal. In this event the main tumour comes away and a shell of bone is left behind. This is easily seized with forceps and dissected out.

Where there is great expansion of the neck of the mandible, with the inevitable elevation of the base of the sigmoid notch, the internal maxillary artery is very intimately associated with the tumour and, owing to its displacement upwards into an abnormal position, it or one of its branches is apt to be injured during removal of the condyloid processes. Preliminary ligature of the external carotid is a great safeguard against undue hæmorrhage from this and other sources and in our operations proved so valuable in preventing even the slightest loss of blood, that in our opinion it should always be performed.

### Alleviation of Deformity.

It is surprising that, in spite of the amount of contraction that occurs, the deformity after removal of half of the mandible is comparatively slight. This is due to the opposite pterygoid muscles pulling the healthy half across the mid-line so that the face, although narrower, remains relatively symmetrical. There is, however, difficulty in mastication because the teeth, if present, are no longer opposed to each other. It would seem that some attempt should be made to counteract this and skilled dental cooperation is necessary. In those cases in which the middle portion of the jaw is removed, it would seem to be a good plan, provided the patient is young, to undertake reconstruction of the jaw by bone graft. This would necessitate fixation of the two separated sections of jaw after operation and could best be carried out as suggested by Goodsell[29] by wiring the upper and lower jaws together while healing took place. In all cases the contraction of the structures on the floor of the mouth is rapid, and it has been suggested by Moore, Hadfield and Claremont,[28] who had much difficulty in a case with contracting scar tissue, that some form of dental splint should be fitted at the time of operation. In their case the post-operative scar tissue had to be excised widely and the floor of the mouth reconstructed by an epithelial inlay graft before a prosthesis could be fitted.

In those cases in which half of the jaw is removed, any bone graft operation is useless and some form of prosthesis should be fitted as soon after operation as possible. This must take its leverage from the upper jaw of the sound side, and should be as heavy as possible in order to exercise steady and even pressure. Unfortunately, as in both our cases, the problem is often made very difficult by the fact that both jaws are edentulous or nearly so, so that fixation of the main supporting denture is very difficult of achievement.

### ACKNOWLEDGEMENTS.

We are greatly indebted to the trouble and care taken in respect to both our cases by Mr. Cloutier, Honorary Dentist to the Royal Prince Alfred Hospital.

We are also grateful to the courtesy of Professor D. A. Welsh and Professor C. Stump, of the Departments of Pathology and Anatomy respectively, for the use of the technical resources of their departments.

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# THE PATHOLOGY OF GANGLION.

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THE easily accessible position of ganglia allows of comparatively complete clinical investigation, but despite the observations of centuries, the nature and cause of the condition elude both practical and philo-

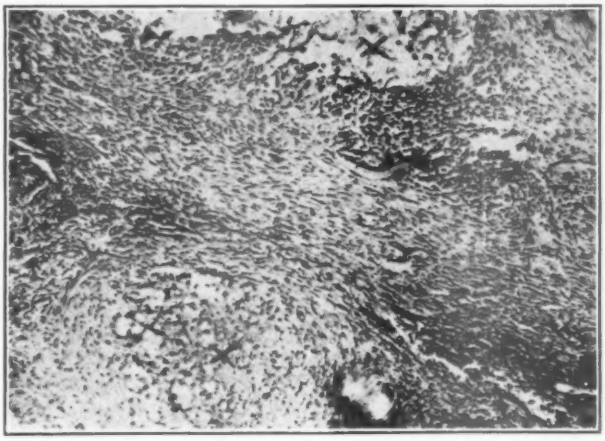

FIGURE I. Photomicrograph of a section taken from the synovial membrane of a tendon sheath in an example of early ganglion, showing areas in which the spindle cells are becoming spheroidal and are undergoing a mucoid change. X indicates the foci of cellular change. × 90.

sophical probing into the question. At the same time, a large amount of information has been collected, and from this certain deductions may be made.

## HISTORICAL.

Ganglion was known to Hippocrates, who referred to "certain flabby gangionic tumours, which were expected by some persons to contain fluid, but contained only a 'mucoid flesh'." From this time, as with most departments of pathology and medicine, until the eighteenth century, only occasional reports were made, as, for example, the description of ganglion and its treatment by Jobi a Meek'ren in the middle of the seventeenth century. Following numerous careful observations during

the last two centuries, several hypotheses concerning the origin of the ganglia have arisen.

In 1746 Eller examined a ganglion which was adherent to a tendon sheath. He considered that it arose from rupture of the tendon sheath, with a subsequent sealing off of the opening at the site of rupture. A related hypothesis was introduced in 1882 by Volkmann.[33] He suggested that the ganglion arose as a herniation of the synovial membrane of tendon sheaths or joints. This is still the popular belief in many places, probably as a result of an observation made by Pick.[26]

FIGURE II. Photomicrograph of portion of the wall of an early ganglion showing the mucoid material and *débris* in the cyst cavity, the layer of spheroidal cells and the outer spindle cell tissue. C = cavity of cyst; L = layer of mucoid material; S = layer of spheroidal cells. × 90.

In 1852 Gosselin[10] concluded that they were retention cysts arising from the "subsynovial crypts and follicles."

One important conception was that these conditions were neoplasms. Henle[12] (1847) considered them as "mucinous tumours," and Hoeftman[14] (1876) described them as "synovial dermoids." Ledderhöse[22] also regarded them as neoplastic, and Meckel referred to them as "serous cysts."

In 1881 Vogt[32] advanced the idea that they arose from bursæ.

These hypotheses do not give very much assistance in understanding the condition, but from this time onward increasingly illuminating views were offered.

Ledderhöse, in 1893, suggested that they arose by cystic degeneration in the connective tissue around a joint or tendon sheath. This was supported by Borchardt,[2] Clarke,[5] Franz,[9] Hofmann,[13] Payr,[25] Ritschl,[27] Thomson[30] and Thorn.[31]

In 1915, Floderus[8] postulated a specialized connective tissue destined, by degeneration, to form joints and tendon sheaths. This he termed an "arthrogenous blastema." He suggested that the ganglion arises from this tissue which occurs in the neighbourhood of joints and tendon sheaths. He considered that the ganglion should be termed an "arthroma." This is an extremely interesting suggestion. Its failure seems to me to be due to its requiring, for the complete explanation, something in the nature of a "cell-rest." It is essential in all explanations

of pathological conditions that we use the normal tissues of the part as far as is possible, and do not introduce extraneous, hypothetical and unnecessary material. This is referred to again.

In 1925 Küttner and Hertel[20] discussed the subject and again brought forward the view of the tumour nature of these conditions. Buxton,[3] in 1923, had classified ganglion amongst the tendon sheath tumours.

Carp and Stout[4] reviewed the position in 1928 and concluded that the ganglion arose by degeneration of the connective tissue round tendon sheaths and joints.

Thus there is no general consensus of opinion regarding the nature of the swellings. As it seemed that the available material allowed of some further definition of the conception of the nature of ganglion, this note is offered.

FIGURE III. Photomicrograph of portion of the wall of another cyst showing a larger cavity (C). The spheroidal cells (S) are relatively fewer. × 90.

## MACROSCOPICAL APPEARANCES.

A ganglion is a cystic swelling containing thick mucoid material, usually having a thin wall and occurring in the region of the capsules of joints or of tendon sheaths. They are three times as common in females as in males.

They occur on the hands and feet and around the knee joint. They are most common in relation to the capsule of the wrist joint, and then in order come the extensor tendon sheaths and the flexor tendon sheaths of the hand. They are much more common on the dorsal aspect of the hand in contradistinction to the tendon sheath tumours which are more common on the flexor aspect.

The ganglia are, as a rule, closely, even intimately, attached to the capsule of the joint or the sheath from which it arises. They do not communicate with the adjacent cavity, although a ganglion communicating with the wrist joint, *post mortem*, was described by Thomas Pick. It is important to remember that since sharp dissection is usually necessary to remove these structures, an artificial communication may result from operative trauma. When a house surgeon, I demonstrated to

my own satisfaction, at that time, that a communication did exist, but this has not been confirmed in recent investigations, owing doubtless to improved technique. The capsule is usually very thin, but occasionally the wall may be thick in part or throughout its whole extent.

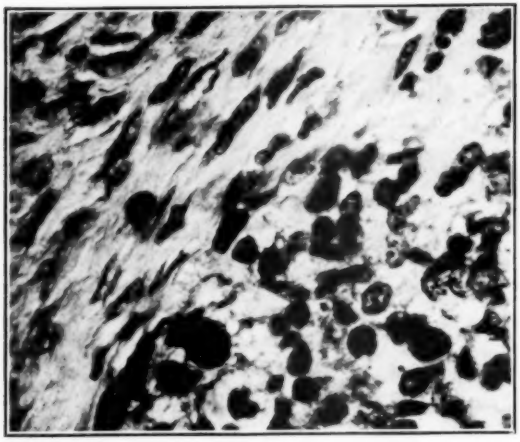

FIGURE IV. Photomicrograph of portion of the wall of a ganglionic cyst showing the spindle cells merging into spheroidal cells. × 450.

Adherence to neighbouring structures may occur, for example, tendon sheaths, vessels, nerves and even the skin, though sometimes the ganglion is not adherent and dissection is easy. It has been stated that spontaneous rupture of a ganglion through the skin has occurred.

On section, the ganglia show in some cases areas of soft tissue, with congeries of small cysts containing thick mucoid material and in other cases one or more large cavities containing a thinner fluid like ordinary joint fluid. In the wall of these cavities are to be found areas similar to those just mentioned. These findings are to be correlated with the microscopical pictures.

## MICROSCOPICAL APPEARANCES.

The microscopical appearances vary with the stage at which the ganglion is examined. I have observed three main varieties of structure which appear to correspond with three fairly definite stages of development.

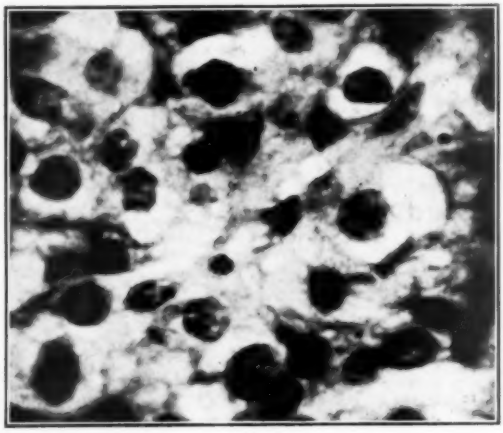

FIGURE V. Higher power view of the spheroidal cells showing the development of droplets of mucin-like material. × 800.

Stage 1 consists of a marked proliferation

of cells of the spheroidal type similar to those observed in tendon sheath neoplasms. Mucoid material occurs in and between the cells (see Figure I).

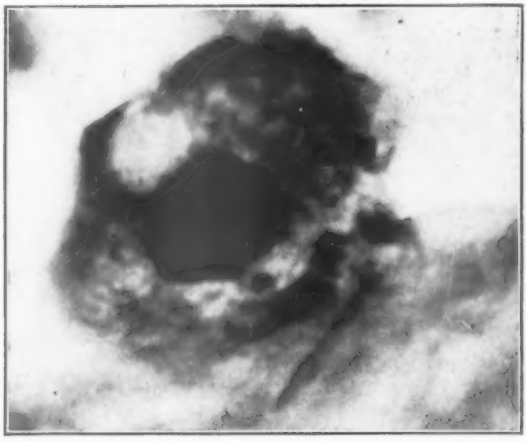

FIGURE VI. High power view of a spheroidal cell showing intracellular droplets and extracellular mucoid material. × 2,000.

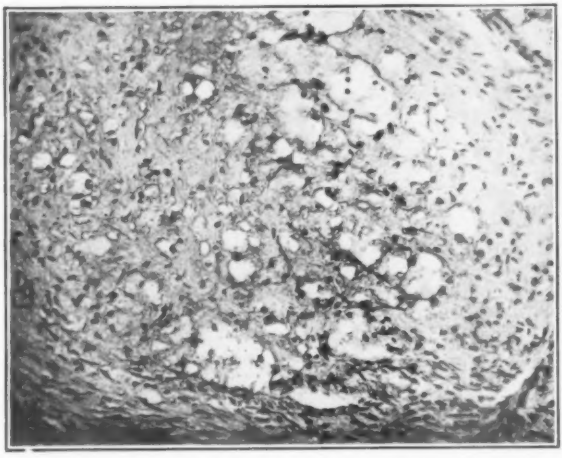

FIGURE VII. Photomicrograph of a relatively acellular form of ganglion formation. Varieties in which even fewer cells are to be found are not uncommon. × 180.

Stage 2 shows the same kind of cells in the wall of a cavity containing mucoid material. (see Figure II).

In Stage 3 there is a well-defined cavity and a well-formed wall containing, for the greater part, spindle cells (see Figure III).

In some examples, different portions of the wall of the ganglion show the various stages, but in general the earlier in its life history that the ganglion is found, the larger the portion that corresponds in structure to Stages 1 and 2, whereas the older forms may show only the appearances of Stage 3. Often only one cavity is present, but sometimes there are many loculi observed, depending, apparently, on the number of foci of pathological activity present. Sometimes there are numerous small cystic spaces in the wall, varying from microscopical spaces to those which approach in size the original cyst.

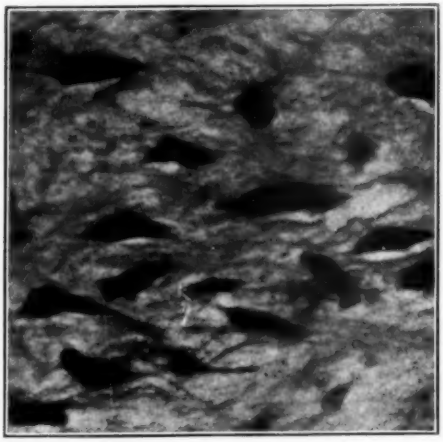

FIGURE VIII. Portion of the wall of a ganglion showing typical spindle cells. (Compare Figure IX). × 600.

*Stage 1.*—The earliest form of ganglion, Stage 1, is characterized by the presence of a large number of spheroidal cells. These are closely packed together and merge directly into homogeneous material which appears to be a secretion of the cells. In the cellular areas the cells are closely assembled (see Figure V), but as the less cellular areas are approached, the cells are separated further from each other until finally there are only a few cells scattered here and there in the surrounding matrix. The cells possess a vacuolated homogeneous protoplasm and a central rounded nucleus (see Figure VI). The cell boundary is ill-defined. Although the cell is spheroidal, protoplasmic processes occur,

FIGURE IX. Portion of the synovial membrane of an inflamed joint showing spindle cells. The similarity of these to the cells in the wall of a ganglion is seen by reference to Figure VIII. × 600.

frequently extending into the surrounding tissue. The vacuoles contain a material which is similar to that occurring in the cavity of the cyst. This material has been shown by Carp and Stout to be mucinoid in chemical nature. These spheroidal cells merge by insensible gradations into spindle cells at their periphery (see Figure IV). In some portions of the inner groups of cells these adopt a spindle character (see Figure VIII). In the wall of these varieties of ganglia various layers may be demonstrated: (i) An outer fibrous layer, the inner cells of which have oval nuclei with open chromatin network. (ii) A middle layer of spheroidal cells with somewhat pyknotic nuclei which emerge on the one hand into the spindle cells lying external to them and, on the other, into the central layer. (iii) An internal layer consisting of mucoid material.

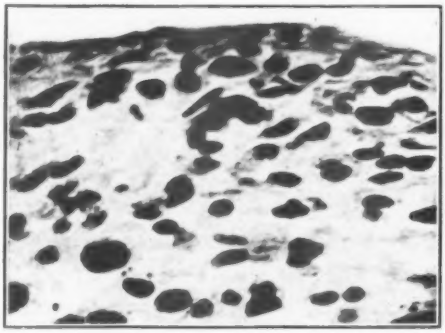

FIGURE X. Portion of the wall of a fully formed ganglion. (See Figure XIV.) The surface is lined by modified connective tissue. × 400.

*Stage 2.*—Stage 2 possesses the features of the first stage, except that the spheroidal cells are much fewer and the central area is beginning to take on the characters of a cavity. Another layer also has been added to those described in the first stage. This occurs between the spheroidal cells and the contents of the cyst. It is a homogeneous layer of variable thickness (see Figure II) and appears to be the secretion of the cells, which is not so fluid as the remainder of the cyst contents. The formation of the cavity may be due to two factors. One is distension due to secretion

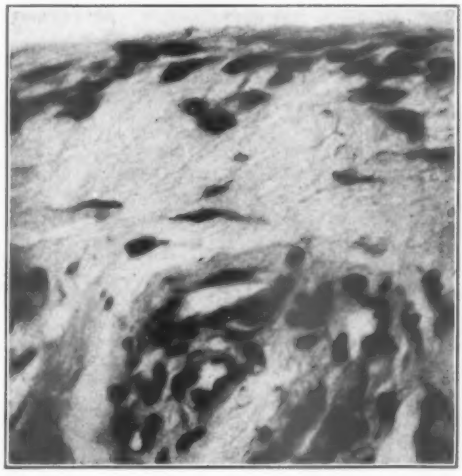

FIGURE XI. Portion of the synovial membrane of an inflamed joint. The general similarity of this tissue to that shown in Figure X is to be observed. × 400.

of the cells and the second is that a certain area of tissue is involved and this, by change of the cells into a spheroidal form and then the formation of mucoid tissue, may determine the approximate size of the space. Both modes of development may be seen. Sometimes all the spheroidal cells undergo the mucoid change concomitantly, so that the mucoid material abuts on to the spindle cell tissue.

*Stage 3.*—Stage 3 is the final form adopted by the cyst and is found in those cases which are of long standing. The wall is smooth and of variable thickness (see Figure XVI). The tissue may be hyaline. The cells in the greater portion of the wall are spindle shaped, and their general arrangement and morphology bear an astonishing resemblance to the synovial membrane of joints. This applies both to the ganglia arising in joints and in tendon sheaths. Comparatively few spheroidal cells are present, though here and there in the wall a collection may be found. It is apparent that these changes are unintelligible unless the nature of synovial membrane and its reactions in abnormal conditions be considered.

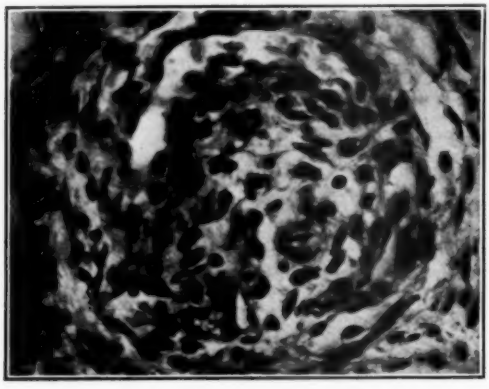

FIGURE XII. Photomicrograph of portion of the synovial membrane of an inflamed joint showing the proliferation of the cells—many of them spheroidal in shape. Such appearances were responsible for the description of "*corpuscles sous-synoviaux.*" × 300.

## NORMAL AND ABNORMAL SYNOVIAL MEMBRANES.

Knowledge concerning the structure of synovial membranes has gone through many phases. In 1763 Bonn showed that the synovial lining of joints was continuous.

At first it was thought to be lined by "epithelium," but with the clarification of opinions that followed the statement by His and Remak of the nature and distribution of the three germinal layers of the embryo, this view was abandoned in favour of an "endothelial" lining. This opinion was expressed by Landzert,[21] Steinberg,[29] Bentzen[1] and Tillmans, amongst others. In 1866, Huerter[15] demonstrated, by the use of silver impregnation methods, that the lining of joints did not have a complete endothelial lining. This view was slightly modified in 1910 by Lubosch,[23] who regarded the structure as being a specialized connective tissue surface. This opinion, which now appears to be on a sound basis,[18] is of fundamental importance in the appreciation of any of the pathological conditions of synovial membrane.

Normal synovial membrane consists of fibrous areolar or fatty tissue, which contains spindle cells, some of which lie on the surface of the

tissue, others are partly embedded, only reaching the surface in part, and still others which lie completely below the surface. There is no similarity to an endothelial lining. These spindle cells merge directly into the underlying connective tissue cells.

In some parts there may be only a very few cells (the "cell poor" synovia of Hammar[11]), while in other portions there may be a comparatively large number of cells (the "cell rich" synovia of Hammar). In these last mentioned areas, some of the cells may assume a spheroidal shape.

The cells of synovial membrane, though described as spindle or spheroidal, only roughly conform to these shapes. The cells have an irregular outline and possess protoplasmic processes (see Figure IX).

When synovial membrane becomes inflamed, the cells proliferate and adopt the same characters as the cells in the "cell rich" areas; that is, they are closely packed together, and many of them are spheroidal in shape (see Figure XII). The cells near the surface are particularly closely related, and these usually contain droplets in the protoplasm. The cell proliferation may sometimes give rise to a "nest" of spheroidal cells. Both the spindle and the spheroidal varieties resemble extremely closely the cells observed in specimens of ganglia. This will now be discussed.

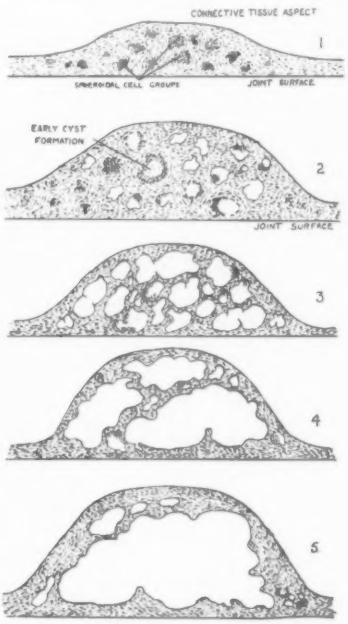


FIGURE XIII. Diagrammatic representation of the mode of formation of ganglion. 1. Synovial membrane in which there are numerous foci of spheroidal cell development. 2. Cyst formation occurring in the spheroidal cell areas. 3. Multiple small cysts. 4. A number of large cysts with associated smaller cysts. 5. Fully formed ganglion—a large cavity with a few associated smaller cysts. In such a case evidence of cell activity may still be found in the neighbouring tissue.

## DISCUSSION.

The close morphological similarity between the hyperplastic synovial membrane and the appearances observed in ganglion are apparent in sections (see Figures VIII, IX, X and XI). In subacute inflammation of the synovial membrane there is a proliferation of the cells resulting in an accumulation which is very similar to that observed in the condition under discussion.

This similarity necessarily results from the circumstance of both lesions arising in the same structure. Any lesion must of necessity be a result of the reaction of the cells of the part to some stimulus and,

though the results may vary somewhat in different cases, there must be many points of similarity, almost identity, since the cells possess and will manifest certain potentialities for proliferation and differentiation.

In the wall of the ganglion the cells are the result of the proliferation of the cells of the synovial membrane of the joint or tendon sheath. As stated, wherever the cells of synovial membrane are numerous, some of the cells are spheroidal in shape, and this applies particularly to inflamed synovial membrane.

The occurrence of secretion droplets also is merely an exaggeration of the morphological characters of the synovial cell. The nature of these droplets will be discussed again.

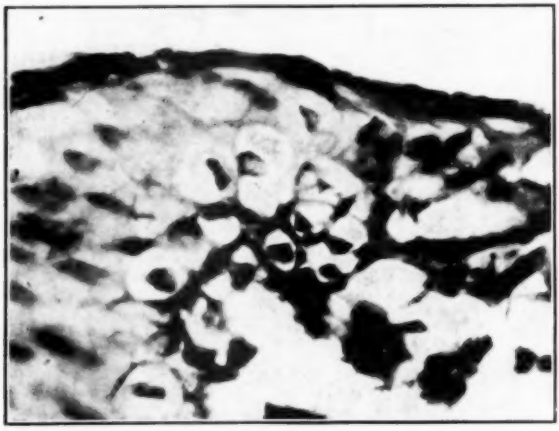

FIGURE XIV. Photomicrograph of portion of a malignant tumour of a tendon sheath. The cells here have become spheroidal and are forming mucin-like material. × 400.

When the active processes are over, the cells revert to their original condition and the majority of them become spindle in shape and the wall of the cyst resembles the structure from which the cells arose—synovial membrane.

Thus the sequence of events may be summarized as follows:

Under the influence of some stimulus (to be discussed later), the cells of the synovial membrane proliferate in exactly the same manner as is observed in other conditions of synovial membrane and the spheroidal cells become numerous.

The cells acquire an excess of the droplets which are commonly to be found in cells of active synovial membrane. This material is apparently discharged into the intercellular tissues until there is a considerable collection separating the cells widely from each other.

The accumulation of the mucoid material in the centre of these areas is associated with disintegration of the cells—the cell wall disappears, the protoplasm merges into the intercellular material and the nucleus becomes pyknotic, then stains faintly and diffusely and finally disappears. This process is similar to that observed in cases of secretion of mucoid material elsewhere in the body.

As the process ceases, the cells return to normal, the cells become spindle shaped once more and the tissues assume their original appearance. There is thus formed a small cyst containing mucoid material, with a wall composed of spindle cells with occasional spheroidal cells.

These small cysts may communicate with each other following on atrophy of the intercystic septa, thus giving rise to larger spaces. Remnants of these septa may be found. No evidence of true papillary development is seen in ordinary cases. Occasionally collections of small round cells are found, but there is no evidence of the conditions being of the ordinary inflammatory type.

FIGURE XV. Photomicrograph of portion of the wall of a ganglion showing the thickening of blood vessels frequently observed. × 180.

We may regard the process as a formation of a "joint cavity" in the synovial membrane of the joint or tendon sheath; that is, the cells of the part have behaved as they did in the original formation of the adult structure from embryonic tissues. They have proliferated, have produced a secretion and formed a cavity.

This is an extremely important principle in pathology and one that is frequently overlooked or not appreciated; the nature of a pathological condition can be explained only in terms of the normal activities of the cells of the tissue concerned. It is unnecessary to postulate the occurrence in a part of peculiar "rests" of tissues which possess mystical properties. It is necessary only to determine the metaplastic possibilities of the tissues already present and these will give the clue to the changes which are taking place.

It is most instructive now to consider the hypotheses which have been suggested.

Gosselin[19] suggested that ganglia were retention cysts arising from a combination of subsynovial crypts and follicles. Such an anatomical conception is as much as could be expected from the period in which it arose, but the idea of the follicles—"*corpuscles sous-synoviaux*"—was a glimmer of light.

The opinion that they arose from bursæ (Vogt[32]) is, in the light of our present knowledge of the nature of the linings of joints and bursæ and their formation in connective tissue, an excellent suggestion, but at the time it was suggested (1881) it was merely an alternative statement of the observations.

The hypothesis advanced by Ledderhöse[22] that the ganglia were degeneration cysts in the capsule or in the connective tissue outside the joint, is very close to the truth. It placed the pathology on a firmer footing and rescued it from the contentions of the neoplastic and hernial nature of the cysts. At the same time, it is only part of the truth. In a very interesting paper in 1928 Carp and Stout also support this view. It is astonishing, however, that though they figure excellent examples of spheroidal cells containing vacuoles of mucinous material, they state: "There has occurred a mucinous degeneration of the collagen. . . ."

The appearances leave no doubt in my mind that the process in question is not a primary degeneration but a secretion. That secretion occurs into joints seems certain, and though the mechanism of the forma-

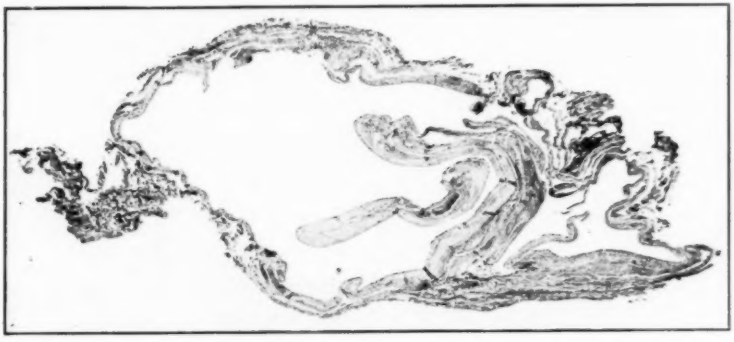

FIGURE XVI. Low power photomicrograph of a well formed ganglion in the late stage. (See Figure IX.) × 6.

tion of the joint fluid is uncertain, as there are droplets in the protoplasm of the synovial cells, it is probable that the fluid arises as a secretion of these cells. Therefore, since the vacuoles occurring in the cells lying in the wall of a ganglion resemble those seen in normal synovial cells and because they resemble the secretion droplets seen in other cells of the body, the process is considered, as stated, to be a secretion rather than a primary degeneration. Restitution of some of the cells occurs in ganglion formation.[1]

The suggestion made by Floderus[8] in 1915 is the nearest approach to the conception here presented. He postulated an "arthrogenous blastema"—a specialized tissue which is destined as the outcome of its

[1] It is to be appreciated that in some cases of physiological secretion (for example, in the case of the epithelium of the bowel) disintegration of the cells occurs.

activities to form joints and tendon sheaths. The only part of this hypothesis that is not acceptable is the introduction of a special tissue. We already have the connective tissue present, the cells of which, in the proper circumstances, possess the potentialities to form joints, bursæ *et cetera*. His opinion that ganglia are neoplasms arising from the "blastema" is only incidental, but it is necessary to discuss this problem.

Several authorities have supported this view of the neoplastic nature of ganglia and the most recent protagonists are Küttner and Hertel.[20] It would seem, however, that the clinical history of many of these cysts is sufficient to dispose of this suggestion. It is not uncommon to obtain the history of the retrogression of a ganglion and the disappearance after breaking or aspiration seems adequate evidence of the non-neoplastic nature of the condition.

FIGURE XVII. Portion of the wall of a fully formed ganglion. The typical spindle cell (connective) tissue is seen. Portion has undergone hyaline change. × 110.

They bear a close relationship to neoplasms of synovial membrane nevertheless, and, as has been explained, this is not extraordinary. One tumour of the tendon sheaths of the *flexor carpi radialis* (to be discussed elsewhere) showed in part of its structure a typical ganglion structure, macroscopically and microscopically. The similarity of innocent tumours to ganglion has been observed on numerous occasions. Figure XII shows that the similarity may extend even to malignant growths. This is taken from a malignant tumour of a tendon sheath. The cells of the growth were of the synovial sheath type and the cells seen here have become spheroidal and have formed a space, the result of secretion or degeneration of the cells. There was no evidence of degeneration in any other portion of the tumour observed.

Another point that has been stressed by some writers must be mentioned. In the walls of a ganglion the vessels are found to be thick (see Figure XIII), and this has given rise to considerable controversy. Some writers, for example, Ritschl[27] and Thorn,[31] have suggested that these vascular changes are the cause of the "degeneration" of the tissues. On the other hand, Payr,[25] Küttner[19] and Carp and Stout[4] regard them as being secondary or concomitant. The evidence

is not in favour of either of these views, since, on the one hand, thickened vessels are to be found in other states of synovial membrane in which there is no suggestion of a ganglion-like formation, and, on the other, I have observed examples of ganglia in which the vessels were not particularly thick. The vascular thickening appears to be an independent phenomenon.

The last problem is that of ætiology. This is one of the most difficult problems for investigation. Females are affected three times as commonly as males. The second and third decades contain most of the cases and there are comparatively few after the fourth decade. Trauma is present in a proportion of cases. Its importance is questionable, since traumata are not commonly accompanied by the formation of ganglion, and numerous strains on the tendon sheaths and joint capsules occur that are not appreciated as injuries. That trauma plays some part seems certain from the examples where intermittent occurrence of the cyst follows the strenuous use of the part, followed by its disappearance after rest.

On the other hand, there is the constitutional factor. It is noticeable that the females affected are usually of slight build. In addition, a ganglion sometimes retrogresses when the general condition of the patient changes. At the present the significance of such observations is beyond our interpretation, though they indicate that the general condition of the patient is important in the ætiology of ganglia.

## SUMMARY.

Ganglion has a characteristic microscopical appearance which varies with the stage at which the cyst is examined.

The mode of formation in which three stages may be recognized is described and various hypotheses are discussed.

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# THE SURGERY OF DIABETIC COMPLICATIONS.

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Surgical operation in diabetics may be necessary either for some intercurrent surgical affection, which has occurred in a diabetic subject quite independently of the diabetes, or it may be required for a surgical affection which is the result of the diabetes, that is, for a complication of diabetes. I propose to consider only the latter, and in this paper, which is mainly based on observations made on a series of diabetic patients admitted to the septic wards of the Melbourne Hospital, I shall deal with the following pathological conditions: gangrene, carbuncle, perforating ulcer.

## Gangrene.

Clinically diabetic gangrene can be classified as follows: (i) Rapidly extending gangrene with a fulminating cellulitis; (ii) gangrene with a slowly extending cellulitis; (iii) localized gangrene with, practically, no spreading inflammatory reaction: arterial gangrene in a diabetic.

There are three well recognized factors in diabetic gangrene: (i) arterio-vascular, (ii) impaired nutritional value of the blood and debilitated condition of the tissues, (iii) trophic conditions associated with a varying degree of peripheral neuritis.

The arterio-vascular condition is a long standing and slowly progressive structural change in the vessel walls. In our patients the degree of vascular occlusion at the site of amputation was not so extreme as in cases of senile gangrene. Still, the fact that diabetic gangrene is never seen in young people, but only in elderly patients with chronic diabetes, shows how important arterio-vascular changes must be.

If the arterio-vascular changes are as important in the causation of gangrene as they appear to be, then it is difficult to understand how the modern insulin treatment of diabetes and its complications can materially affect such chronic arterial changes. Its beneficent action in these circumstances must be concerned with the second and third factors: that is, with the improvement of the nutritional value of blood and the vitality of the tissues and trophic conditions.

The degree of arterial occlusion was difficult to assess in our cases. Moskowicz's test or its modification, which depends on the adequacy of the collateral circulation, does not help much in this respect. A better indication of the arterial occlusion is obtained by estimating the efficiency

of the peripheral circulation, by noting the pulsation of the arteries of the limb, and the general state of nutrition of the part of the limb adjoining the gangrenous area. Moreover, Moskowicz's test has the disadvantage that a tourniquet must be applied to the limb for five minutes. This cannot be considered good treatment in a limb which is the subject of commencing gangrene.

Impaired nutritional value of blood, debilitated condition of tissue and trophic factors are dependent on the diabetic state. It is therefore by controlling this state and improving these conditions that insulin helps in the treatment of gangrene or of threatened gangrene.

The effect of insulin, as seen from our observations, was as follows: (i) It caused resolution in pregangrenous cellulitis. (ii) It brought about healing, with operative treatment, in small localized patches of gangrene. (iii) It rendered possible a local, instead of a general amputation; for example, amputation of the toes instead of amputation of the leg. (iv) It improved the patient's general condition and minimized the risk of a major operation.

Equipped with this knowledge of the value of using insulin, we treated cases of cellulitis in the neighbourhood of gangrene of the toes or feet, as far as possible, by postponing all surgical intervention till the patient's urine was sugar free for a period of ten days, on an adequate carbohydrate diet, controlled by the administration of insulin. The diet was based on Lawrence's "line" diet chart, and was worked out by the physician in charge of the patient, or by the Medical Registrar. The caloric value of the diet aimed at was sixteen hundred calories, but this could not always be attained. The period of ten days sugar free on an adequate diet controlled by insulin was not regarded as a necessarily ideal period of pre-operative treatment, but rather as a minimum within which it was inadvisable to undertake any active measures, unless they were urgently called for.

Certain pathological conditions prevented this line of pre-operative treatment from being carried out. These were: (i) The rapid spread of the surrounding infection; (ii) cellulitis or local abscess formation, necessitating incisions; (iii) the rapid spread of gangrene. In two patients admitted to hospital in a moribund condition, rapidly spreading gangrene did not admit of any pre-operative treatment and rendered them hopeless surgical problems.

The post-operative treatment was carried out on lines somewhat similar to the pre-operative treatment. Special care was taken to guard against post-operative acidosis by giving the patient, two hours before the operation, a drink containing forty grammes of glucose and an injection of twenty units of insulin.

*Treatment of Diabetic Gangrene by Periarterial Sympathectomy.*—To the effect of the structural changes in the vessel wall, which deprive the limb of nourishment, there must be added the neurogenic factor, sympathetic innervation, which controls the calibre of the lumen of the vessel and varies the blood supply to the limb.

With a view to improving the circulation, Leriche and Sampson Handley have advocated the operation of periarterial sympathectomy of the main arteries in the gangrenous limb. This can be done either by mechanically stripping off about 7·5 centimetres (three inches) of the outer coat of the artery, or by destroying the sympathetic net with an injection of alcohol into the arterial coat (Handley).

Mr. Harold Dew performed this latter operation, under local anæsthesia, on two of the patients whose case histories are reported in this series (Table V). The results of the operations were unsatisfactory and no appreciable results were obtained.

Adverse criticism of periarterial sympathectomy is that local operations on the arterial wall are too limited, that some of the sympathetic connexions may be missed, and that section of these nerve fibres closer to the central nervous system is more desirable.

In regard to other diseases associated with diabetes, albuminuria, indicating the presence of associated renal disease, was present in 20% of cases. That it was unaccompanied by a high blood pressure was of little significance in these debilitated patients.

## Anæsthesia.

Nitrous oxide and oxygen were used in nearly all cases. Ether and chloroform, as anæsthetics for diabetics, are very dangerous. Although we were impressed with the value of spinal anæsthesia in war-time surgery, a trial in these cases, before the advent of nitrous oxide-oxygen anæsthesia, soon showed that these debilitated patients were not able to withstand the fall of blood pressure that followed. Our experience showed that nitrous oxide gas anæsthesia was superior to all other anæsthesia. There is not nearly so great a fall of blood pressure as with spinal anæsthesia, and post-operative acidosis is much less severe and much more easily controlled than with ether anæsthesia, because the patient is soon conscious and can cooperate with the surgeon almost as soon as the operation is completed.

## Diet.

In the treatment of these diabetic cases, before and after operation, the diet used in combination with insulin treatment was selected from the following diet chart—the Lawrence "line" diet chart. This chart is as follows.

"Black" Rations (5 grammes of carbohydrates)—

5 ounces of 5% vegetables: Cabbages, cauliflower, lettuce, spinach, cucumber, asparagus, marrow, rhubarb (stewed), celery, tomatoes, water-cress, radishes.

2 ounces of 10% vegetables: Carrots, onions, turnips, beets, French beans.

1½ ounces of 15% vegetables: Oranges, strawberries (raw), gooseberries, peaches, pineapple, melon.

1 ounce of 20% vegetables: Peas, artichokes, parsnips, pears (raw), apples (raw), raspberries (raw), currants, cherries, apricots.

1 ounce potato (one medium size = 4 ounces).

1 ounce banana (one average banana = 3·5 ounces).

½ ounce oatmeal (uncooked).

½ ounce bread.

"Red" Rations (7·5 grammes protein and 15 grammes fat)—

2 ounces of ham or pork chops.
1 ounce of lean bacon.
1 egg and ½ ounce of fat.
1½ ounces of lean beef, ½ ounce of fat.
1½ ounces of lamb, mutton or fat beef with ¼ ounce of fat.
1½ ounces of smoked sausage or fowl, with ½ ounce of fat.
1½ ounces of sardines with own oil.
1 ounce of cheese and ¼ ounce of fat.
1 ounce of tongue and ¼ ounce of fat.
1½ ounces of lobster or salmon, fresh or tinned, and ¼ ounce of fat.
1 ounce of rabbit or white fish, ½ ounce of fat.
1 ounce of chicken and ½ ounce of fat.
3 ounces of veal cutlets and ½ ounce of fat.
1 ounce of liver and ½ ounce of fat.
1¼ ounces of kidney or tripe and ½ ounce of fat.
1 egg—2 ounces of lean bacon = 2 rations.

The "lines" described as "black" have a certain carbohydrate value, and those described as "red" have a certain protein and fat value. It is thus convenient to prescribe a certain number of "black" lines or of "red" lines in order to administer a correctly balanced diet with the requisite number of units of insulin. From this diet it is also easy to calculate the number of calories required.

## Comment.

There is very little to be learned from a study of Table I. It only shows that

TABLE I.

| Initials. | Sex. | Age. | Duration of Diabetes | Complication and its Duration. | Sugar. | Acetone. | Diacetic Acid. | Albumin. | Blood Pressure. | Blood Sugar. | Preoperative Insulin Treatment. | Calories. | Treatment. | Result. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A.G. | F. | 52 | 2 years. | Gangrene one foot, 3 weeks. | + | + | | + | 138 | 0·16% | 20 grammes and 20 units 2-hourly till sugar free, and then 7 diet lines and 50 units daily. | 1,205 | Refused operation. | Died in few days. | |
| S.T. | F. | 65 | 1 year. | Gangrene three toes, 14 days. | + | + | + | Nil. | | 0·39% reduced to 0·18% | 5 lines worked up to 7 lines and 25 units three times a day and sugar free. | 1,295 | Refused operation. | Died in 2 months. | Though sugar free, gangrene spread. |
| M.S. | F. | 66 | 4 months. | Gangrene to knee. | + | + | + | + | | 0·30% | 30 units insulin, 30 grammes glucose 2-hourly. | | | Died day of admission. | |

TABLE II.

| Initials | Sex | Age. | Duration of Diabetes | Complication and its Duration. | Sugar. | Acetone. | Diacetic Acid. | Albumin. | Blood Pressure. | Blood Sugar. | Preoperative Insulin Treatment. | Calories. | Treatment. | Result. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P.C. | M. | 61 | 6 weeks. | Gangrenous patch, 2 toes. | Nil. | Nil. | Nil. | Nil. | | 0·10% and a diabetic curve. | *B.M. diet for six weeks. | 1,475 | Incised. | †R.D. on 1,620 cal. with 5 units twice a day. | |
| M.J. | F. | 60 | ? years. | Gangrene little toe. | + | + | + | Nil. | | 0·24% | 8 lines, but patient was not always sugar free. | 1,480 | | R.D. with patch separated and healed. | Difficult to diet. |
| E.R. | F. | 47 | 2 years. | Gangrene right big toe. 4 months. | + | Nil. | Nil. | Nil. | 180/80 | 0·25% | 1,475 calories with 10 units three times a day; sugar free. | 1,475 | | R.D. healed. | Spirit dressing. |
| G.K. | M. | 59 | Indefinite. | Gangrene one toe, 4 months. | + | + | + | Nil. | | 0·20% | Sugar free on 9 lines and 10 units daily. | 1,665 | | R.D. healed. | Spirit dressing. |

*B.M. = Basal Metabolic. †R.D. = Returned to duty.

these patients applied too late for treatment, that they were so far advanced in the diabetic state and that the gangrene was so extensive that even modern insulin treatment could make no impression on them.

An analysis of Table II teaches a valuable lesson and shows that under insulin treatment, with increase of carbohydrate tolerance, patients who present themselves for treatment with localized patches of gangrene or with areas of pregangrenous cellulitis of the foot, have a very reasonable chance of escaping an amputation or even an operation of any sort. In the main, the treatment carried out was: incisions where necessary, resection of patches of necrotic skin, the use of dry dressings.

Table III includes those patients on whom local amputation was performed. Although the wisdom of this procedure may be questioned, it is certain that the scope for local amputation has been considerably extended by the use of insulin. One of the main obstacles to success in this limited operation

is the site of the gangrene. This is exemplified in the one failure in this particular series—a gangrene of the big toe. The reason for this is that while it is possible to cut flaps for the four outer toes, it is very difficult, when the site of the gangrene is the big toe, to get a flap big enough to cover the large head of the first metatarsal bone. At the same time, it is often advisable to risk this operation, as was done here, because amputation further back leaves a weak foot.

McKittrick in his book, "Diabetic Surgery," states that the arterio-vascular conditions in diabetic and senile gangrene are not analogous. He quotes experiments to show that local amputation is doomed to failure in senile gangrene, but offers some reasonable prospect of success in diabetic gangrene. McKittrick investigated the vascular conditions in legs amputated for gangrene by injecting into the arterial system material opaque to X rays and then taking skiagrams of them. He found that in limbs from chronic diabetics with a slowly progressive arterial occlusion the collateral circulation was often well developed, and that when complete occlusion of the main vessel occurred, it was sufficient to carry on the vitality of the limb till injury or infection resulted in thrombosis of a digital or pedal vessel, whereupon gangrene

TABLE III.

| Initials. | Sex. | Age. | Duration of Diabetes | Complication and its Duration. | Sugar. | Acetone. | Diacetic Acid. | Albumin. | Blood Pressure. | Blood Sugar. | Preoperative Insulin Treatment. | Calories. | Treatment. | Result. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L.D. | *M.* | 57 | Indefinite. | Gangrene little toe, 2 weeks. | + | + | + | Nil. | | 0·24% reduced to 0·16% | 10 diet lines; 10 units. Sugar free and kept so for 3 weeks before operation. | 1,850 | Local amputation. Anæsthesia, $N_2O + O_2$. | *R.D. in 28 days. | |
| J.B. | *M.* | 62 | 1 year. | Gangrene big toe, 1 week. | + | + | Nil. | Nil. | 165/100 | 0·30% reduced to 0·135% | 12 lines and 20 units at talmi and sugar free, 20 days' treatment. | 2,220 | Local amputation. Anæsthesia, $N_2O + O_2$. | Failure. | Later amputation through thigh. |
| P.S. | *F.* | 59 | ? years. | Gangrene second toe, 2 weeks. | + | + | + | + | | 0·25% reduced to 0·14% | 9 diet lines and 10 units twice daily and sugar free for 18 days. | 1,665 | Local amputation. Anæsthesia, $N_2O + O_2$. | R.D. healed, 6 weeks | |

*R.D. = Returned to duty.

TABLE IV.

| Initials. | Sex. | Age. | Duration of Diabetes | Complication and its Duration. | Sugar. | Acetone. | Diacetic Acid. | Albumin. | Blood Pressure. | Blood Sugar. | Preoperative Insulin Treatment. | Calories. | Treatment. | Result. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| J.B. | M. | 62 | 2 months. | Gangrene big toe, 1 week. | + | Nil. | Nil. | Nil. | 165/100 | 0·30% reduced to 0·135% | Sugar free on 12 lines and 20 units. | 2,220 | Supra-condylar amputation. Anæsthesia, $N_2O+O_2$. | †R.D. 1 month. | Local amputation had failed. |
| J.C. | M. | 78 | | Gangrene left foot. | + | + | + | + | | 0·37% reduced to 0·20%. | Worked up from 5 lines to 9 lines with 30 units twice a day and sugar free. | 1,665 | Amputation middle third thigh. Anæsthesia, $N_2O+O_2$. | R.D. in 3 3 weeks. | |
| E.S. | M. | 63 | 4 months. | Gangrene dorsal aspect foot and toes. | + | Nil. | Nil. | Nil. | | 0·40% reduced to 0·175% | Worked up to *B.M. diet, with 30 units daily, sugar free, 10 days. | 1,475 | Amputation through knee Anæsthesia, $N_2O+O_2$. | Died. | Flap sloughed. Bed sores, *et cetera*. |
| I.H. | F. | 61 | ? years. | Gangrene right foot, 2 weeks. | + | + | + | Nil. | | 0·26% reduced to 0·15% | 9 lines and 20 units and sugar free for 17 days. | 1,665 | Amputation middle third thigh. Anæsthesia, $N_2O+O_2$. | R.D. in 5 weeks. | |

*B.M.—Basal Metabolic. †R.D.—Returned to duty.

occurred. If the collateral circulation was sufficient to localize the gangrene, then local amputation might succeed. In senile patients, with complete occlusion of the parent vessel, practically no collateral circulation had developed and local amputation could scarcely hope to succeed.

In Table IV it will be noticed that the amputations in the middle third and supracondylar regions, fairly high amputations, were successful, while the lower operation, amputation through the knee joint, was a failure. In this particular instance, the high amputation was not admissible for the following reasons: It was thought that a minimum of operative trauma might help to preserve the vitality of the flap and that this should be obtained by using a circular cuff amputation through the knee, where the flap would be of the same length in all its circumference, where there would be no in-

cision parallel to the axis of the limb and, further, where there would be no division of bone. Prior to operation, it was recognized that the long cuff that would be necessary to cover the medial condyle would have a precarious circulation, and that it was not good surgery to perform amputation through a joint in the presence of a septic condition and, further, that the patient might subsequently wish to wear an artificial limb. But, in view of the desperate condition of the patient, a short operation which would open the tissues as little as possible, was considered best in the particular circumstances. It would not seem right that we sould let this limited experience prevent us from employing this rather conservative amputation in the future.

## CARBUNCLES.

During the period in which these observations were made, six patients with carbuncle were admitted to the ward. Of these, three died and three recovered. In all these patients the treatment of the underlying diabetic condition was carried out on the same lines as in diabetic gangrene. Blood sugar estimations were made; the carbohydrate diet, protected by the requisite amount of insulin, was increased in order to fill up the glycogen store in the liver.

Of the three patients who recovered (Table VI), only one was treated by operation. Nitrous oxide and oxygen were administered, crucial incisions were made and the slough was cut out. The wound was then mopped with pure carbolic acid, followed by alcohol. Subsequently the wound was grafted by Thiersch's method.

TABLE V.

| Initials. | Sex. | Age. | Duration of Diabetes | Complication and its Duration. | Sugar. | Aceto. | Diacetic Acid. | Albumin. | Blood Pressure. | Blood Sugar. | Preoperative Insulin Treatment. | Calories. | Treatment. | Result. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E.T. | *F.* | 65 | | Gangrene of foot. | + | + | + | Nil | | 0·26% | 7 red and 9 diet lines, black lines and 25 units daily. | 1,101 | Periarterial sympathectomy and ligature of femoral vein. Local anæsthesia. | Failure. | Subsequently amputated and died. |
| E.M. | *F.* | 61 | | Gangrene big toe. | + | + | + | Nil. | | 0·19% | 6 red and 6 black lines and 15 units sugar free. | 1,110 | Periarterial sympathectomy with ligature of femoral vein. Local anæsthesia. | Failure. | Subsequent supra-condylar amputation successful. |

TABLE VI.

| Initials. | Sex. | Age. | Duration of Diabetes | Complication and its Duration. | Sugar. | Acetone. | Diacetic Acid. | Albumin. | Blood Pressure. | Blood Sugar. | Preoperative Insulin Treatment. | Calories. | Treatment. | Result. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| K.P. | *F.* | 60 | | Carbuncle neck, 3 weeks. | + | + | + | + | | 0·33% | Sugar free on 7 lines and 30 units daily. | 1,191 | Magnesium sulphate and glycerine dressing. | †R.D. in 6 weeks healed. | |
| C.S. | *M.* | 59 | | Pain and swelling neck, 5 weeks. Large fluctuant area. | + | + | + + + | | | | 80 grammes of glucose and 40 units insulin 3-hourly. | | Incision under $N_2O + O_2$. | Died one day later. | |
| L.O. | *F.* | 39 | | Carbuncle, face, 3 days. | + | + | | | | 0·16% | 60 grammes glucose, 30 units insulin till sugar free. | | Magnesium sulphate and glycerine. | R.D. in 10 days. | |
| J.A. | *M.* | 43 | | Carbuncle of arm and neck. | + | + | + | | | 0·25% | 60 grammes of glucose and 30 units insulin till sugar free. | | Incision one day after admission under $N_2O + O_2$. | R.D. | Skin graft necessary. |
| T.B | *M.* | 59 | | Carbuncle opened before admission to hospital; on admission large abscess of thigh. | + | + | + | + | | 0·33% | 100 grammes of glucose and 50 units insulin till sugar free and then 7 lines and 20 units daily. | 1,191 | Incision under $N_2O + O_2$. | Died in 7 days. | Septicæmia. |
| T.G. | *M.* | 73 | | Carbuncle neck, 14 days. | + | + | + | | | 0·17% reduced to 0·15% | *B.M. diet raised later to 35 calories per kilogram of body weight. | 1,475 | Incision of carbuncle and abscesses. | Died in 1 month. | Septicæmia. |

*B.M. = Basal Metabolic. †R.D. = Returned to duty.

The remaining two patients were treated by the application to the carbuncle of a paste of magnesium sulphate and glycerine.

Of the three patients who died, two were operated on. One died seven days and the other several weeks after the operation. In the latter patient the local focus had almost healed, but multiple metastatic abscesses had developed. We regarded the condition in this instance as a low grade septicæmia, notwithstanding the fact that we could not culture an organism from the blood. The former patient presented a clinical picture of an acute toxæmia and died the day after admission.

A consideration of the case histories in this table raises the question whether the treatment of carbuncles in diabetics should be operative or conservative. Our opinion is that operation should be reserved for those patients in whom there is a very rapid spread of the process

TABLE VII.

| Initials. | Sex. | Age. | Duration of Diabetes | Complication and its Duration. | Sugar. | Acetone. | Diacetic Acid. | Albumin. | Blood Pressure. | Blood Sugar. | Preoperative Insulin Treatment. | Calories. | Treatment. | Result. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H.J. | M. | 52 | | Peripheral neuritis. Perforating ulcer, 2 months. | + | + | | | | 0·21% | 9 lines and 20 units three times a day. | 1,665 | | *R.D. in 21 days. | |
| A.S. | F. | 55 | | Perforating ulcer fifth metatarsal. | + | + | | | | 0·14% | Sugar free on 9 lines, with insulin. | 1,665 | | R.D. healed. | |
| S.C. | F. | 59 | | Perforating ulcer. Peripheral neuritis. | | | | | | 0·21% | 7 lines and 7 units three times a day and sugar free. | 1,191 | | R.D. in 8 8 weeks. | |
| M.B. | F. | 56 | | Perforating ulcer. Peripheral neuritis. | + | + | + | | | 0·25% | 9 lines and 10 units of insulin three times a day and sugar free. | 1,665 | | R.D. in 4 weeks. | |
| E.F. | F. | 71 | | Peripheral neuritis and ulcer of big toe. | + | + | | | | 0·26% | 8 lines and 10 units of insulin three times a day and sugar free. | 1,480 | Curetted under $N_2O+O_2$. | R.D. in 5 weeks. | |
| E.W. | F. | 60 | | Perforating ulcer with osteomyelitis. | + | + | | | | 0·19% | 9 lines and sugar free. | 1,665 | Incision and drainage under $N_2O+O_2$. | R.D. | |

R.D. = Returned to duty.

or who complain of very severe pain. The objections to the operation are the risk of septicæmia and the prolonged convalescence due to retraction of the skin flap. Our preference is to treat these patients with compresses made of magnesium sulphate and glycerine, and we operate only when the indications mentioned above are present.

It would appear from a study of this very small series that operation on carbuncles tends to be followed by a blood infection and the development of abscesses at a distance. To try to eliminate this risk of blood infection, such patients are now being operated on with the diathermy knife.

## PERFORATING ULCER.

In this series there were six cases of perforating ulcer complicating diabetes, and of these two cases had a fully developed peripheral neuritis (see Table VII).

The site of the ulcer was under the head of the first metatarsal bone in two cases, and under the fifth metatarsal bone in four cases. Operative treatment was resorted to in only two cases, in which X ray examination revealed a gross osteitis in one case with a sequestrum. The other three cases were treated by local application, dry dressings or saline solution or eusol dressings; but with an adequate diet controlled by insulin treatment the local application is of secondary consideration, though dry dressings are preferable.

In the two cases with gross osteitis as revealed radiologically, operative interference was considered essential to hasten convalescence, but it is quite possible that in time the osteitis would heal unaided by local treatment. As regards convalescence of the patients operated on, one was discharged with the ulcer healed fourteen days after curetting, the other ulcer took five weeks to heal. The dietetic treatment was identical with that used in the other tables; the patient was maintained sugar-free on an adequate diet controlled by insulin.

## SUMMARY.

1. With insulin treatment, pregangrenous cellulitis of the toes and small localized patches of gangrene will often heal without any active intervention, though incision may be necessary in some cases.

2. In picked cases, local amputation is worthy of consideration.

3. Carbuncles should be opened only because of rapid spread or severe pain. The risk following incision is blood infection: it is possible that this may be lessened by the use of the diathermy knife.

4. Perforating ulcers, even when complicated by osteitis of the metatarsal bone, heal readily under insulin treatment.

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# DIABETIC GANGRENE.

By Ewen Downie.

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The successful preparation of insulin in 1921 has been followed by a marked improvement in the outlook of the diabetic patient. The average expectation of life has increased considerably and, in addition, it is now possible to subject a patient safely to major surgical procedures which would have proved fatal ten years ago. This alteration in the course of the disease, however, has unfortunately produced a change in the appearance and in the importance of certain sequelæ. Amongst the most frequent and the most serious of these complications is the tendency for diabetics to develop vascular changes, and at the present time it would appear that, although there is an increased expectation of life, there is also a greatly increased liability to the development of cardio-vascular damage. The importance of this effect of the modern treatment of *diabetes mellitus* is already being recognized. Joslin[1] has shown that, although the death rate in diabetics from coma has greatly decreased since the introduction of insulin, there has been an enormous increase in the death rate from vascular disease, which is now responsible for about 50% of the deaths in these patients. Likewise, Wendt and Peck[2] have stated recently, after analysing over one thousand cases, that "arteriosclerosis is now the greatest problem in diabetic management."

Before entering upon any consideration of diabetic gangrene *per se*, it is advisable to consider the problem of arteriosclerosis in some detail, as it is a most important predisposing cause. From the clinical aspect there are certain peculiar features of diabetic vascular disease which call for comment. A definite period of time seems necessary before vascular disease develops. Joslin[3] has stated that after five years every diabetic is arteriosclerotic, but it is probable that the initial lesions occur earlier than this. With regard to the vessels affected, there is a striking difference from other forms of vascular disease, in that the main incidence of the damage appears to fall on the muscular arteries, and, in consequence, the vascular accidents occur in the coronary arteries, producing coronary infarction, and in the vessels of the extremities, particularly of the leg, predisposing to the development of gangrene. There is a notable lack of the usual type of vascular accident, such as cerebral thrombosis or hæmorrhage, which is usually associated with other forms of arteriosclerosis. Again, there is an absence of hypertension in the diabetic patient, and analyses of groups of cases show that the blood pressure findings are little removed from the normal. Another

disquieting feature is that this vascular change may progress to a marked degree without yielding the slightest sign of its presence, and it is a matter of extreme difficulty, even when arterial damage is suspected, to estimate successfully its distribution and extent. It is common enough on examining the vessels of a leg amputated for diabetic gangrene to discover that either the anterior or posterior tibial artery is the site of an obliterative arteritis which has rendered it functionally useless.

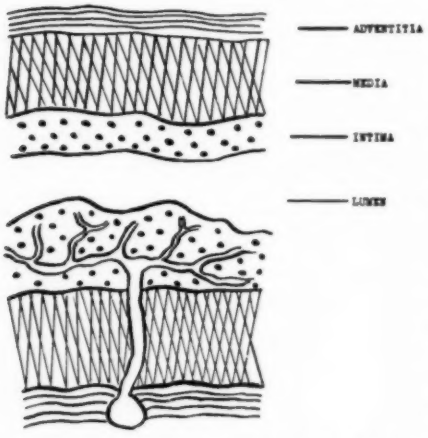


FIGURE I. Longitudinal section of an artery to show invasion of the intima by *vasa vasorum* from the adventitia (diagrammatic).

Although from the clinical side there is unanimity in the observed incidence of the vascular changes, little attention has been devoted to the pathological aspects of this question. Apart from recognizing *diabetes mellitus* as a cause of arteriosclerosis, most authorities dismiss it at once. Buerger[4] states that the pathology of diabetic vascular disease and of arteriosclerosis is the same. Warren,[5] however, has recently drawn attention to the involvement of the muscular arteries, and Letulle, Labbé and Heitz[6] have pointed out certain hitherto undescribed appearances in the intima of muscular arteries. These are of such importance as to warrant further attention. In the course of the past eighteen months the writer has examined material from sixteen cases of gangrene of the leg, the results of which will now be considered.

In every case extensive and widespread vascular damage was present, and in fourteen of the series obliterative changes in one or more of

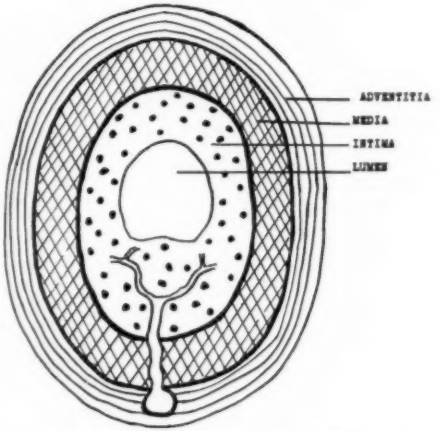


FIGURE II. Transverse section of an artery showing invasion of the intima by adventitial vessels and commencing encroachment upon the lumen of the artery (diagrammatic).

the main arteries of the limb were found. These were of such degree as to occlude the vessel completely, which in some cases resembled a fibrous cord without a sign of patency. In other cases, although actual obliteration had not occurred, the lumen of the affected vessel was reduced to a small fraction of its original size. In general, these changes were found to be most marked in the larger muscular arteries, such as the popliteal, the anterior and posterior tibial, the lateral plantar and the *dorsalis pedis*. The smaller vessels and the arterioles and capillaries did not appear to be affected to nearly the same extent.

In certain cases it appeared that the obliterative process resulted from degenerative and organizing processes in the intima. In some, definite evidence of clot formation was found, suggesting that the final occlusion resulted from an intraarterial thrombosis, and there were signs of organization and of canalization of clot. Evidences of attempts at the formation of collateral vascular channels were frequent, and the safety of the affected limb appeared to rest, at least in some instances, on their efficiency.

FIGURE III. Anterior tibial artery in Case III, showing new vessels in the intima. × 10.

A wide variation existed in the microscopical findings in the various cases examined in this series and, in consequence, the salient features only will be described here. Of paramount importance were the intimal changes which were present in some form or another in every case. In some a marked aggregation of fats and of lipoids, frequently affecting the deeper layers of the intima, was found. Aggregations of cholesterin crystals were observed associated with a chronic type of inflammatory reaction in the vessel wall showing foreign body giant cells and organizing fibrous tissue. In others there was a bland hyaline thickening of the intima with little or no evidence of inflammatory reaction. In six cases of the series entirely different changes were observed.

Letulle, Labbé and Heitz[6] described the occurrence of new vascular channels in the intima of a muscular artery of a diabetic patient. Six cases, as already mentioned, showed this appearance. By serial section it was possible to determine that these vessels originated from the direct invasion of the intima by vessels arising in the adventitia and traversing the muscularis. The effect of this vascularization of the intima was found in the development of fibroblasts and an organizing

connective tissue which apparently developed, at least in some instances, to complete obliteration of the intima by a tissue which is never found normally in the intimal coat. The various stages in this process are well illustrated in the accompanying photomicrographs. The most important result of this process of intimal vascularization would seem to be a gradual and progressive encroachment upon the lumen of the artery, of such an extent as to render it functionally useless. A striking feature in many of the cases examined was the patchy character of the changes found. An area of occlusion in a vessel is followed distally by patency of the vessel which may show little evidence of any vascular change.

FIGURE IV. Anterior tibial artery in Case III. Higher magnification of Figure III. × 100.

In the *lamina elastica interna* fragmentation and splitting were observed in many instances, usually associated with degenerative and organizing processes in the intima.

In the muscular coat changes were observed in all the cases examined, varying from atrophy of the muscularis from disuse in the occluded vessels to degenerative changes, fatty degeneration and infiltration, calcification and even ossification. In a few cases slight evidence of a chronic inflammatory reaction was found with infiltration of this coat with small round cells. In no case was there any sign of acute inflammatory reaction in the vessel wall, nor was any sign of periarteritis discovered.

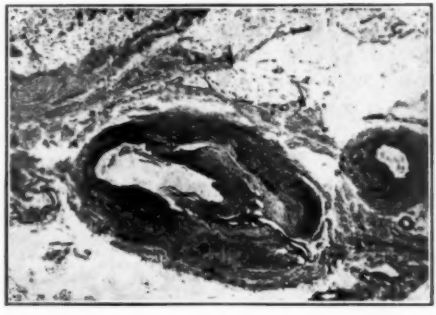

FIGURE V. Anterior tibial artery in Case III. Serial section following Figure III, showing the origin of new intimal vessels. × 10.

The only noticeable change in the adventitia was an increase in the number and size of the periarterial arterioles, suggesting an attempt at the formation of collateral channels of circulation in situations where the main artery had ceased to function adequately.

The changes observed in the veins were slight. Signs of medial degeneration, rarely progressing to calcification, were found in a few cases. No characteristic changes were found in the intima.

The examination of the smaller arteries and arterioles of the foot was frequently complicated by their proximity to gangrenous processes. In consequence, the appearances were at times modified by the presence of a complicating process of infection. In areas distant from gangrenous processes the arterioles and capillaries showed little alteration in structure. Occasionally signs of intimal activity were seen, but, in general, the healthy appearance of the smaller vessels was in marked contrast to the gross changes observed in the main vessels.

FIGURE VI. Anterior tibial artery in Case III. Higher magnification of Figure V. ×100.

The average age of the patients considered in this series was sixty-eight years, and *diabetes mellitus* had been present (as far as could be reasonably ascertained) for an average of 5·5 years. The Wassermann test, carried out in all but two cases, yielded no reaction.

At this stage it is not possible to make any dogmatic statement that a specific diabetic arteritis occurs, but the occurrence of extreme changes in the muscular arteries is a striking feature.

Of the predisposing factors in the development of diabetic gangrene, vascular changes are of primary importance. The tissues are hampered in their efforts to deal with any condition which makes a demand for an increased vascular supply. It would appear that many of these cases exist on an absolutely minimal circulation, which cannot respond to any increased demands made upon it. Another important factor is the lowered resistance of diabetic tissues in general to trauma or infection which occurs as a result of the excessive sugar content of the blood. As a result, gangrene may develop from comparatively trivial injuries which would produce little or no effect upon a normal individual.

The exciting factors in the development of gangrene are trauma and infection. A slight injury, even such as the careless paring of a corn or the cutting of an ingrowing toe nail, is sufficient to start a patch of gangrene or to permit of the entry of infection. The subsequent course of the case depends then upon the degree of vascular response which is possible and upon the virulence of the infecting organism. It is not uncommon to find that as a result of enforced rest the stimulus to

the maintenance of the circulation ceases and, in consequence, a further decrease in the vascular supply occurs.

This is well illustrated by a case in this series in which a gangrene of the foot developed in a woman of sixty-four years, who was admitted to hospital in diabetic coma. The tissue depletion during the coma, together with the cessation of the stimulus to circulation provided by muscular exertion because of enforced rest in bed, resulted in the spontaneous development some ten days later of a gangrenous patch on the dorsum of the foot, which slowly progressed and eventually necessitated amputation of the leg.

The presence of gangrene or of other evidence of circulatory impairment shows the need for some method of estimating the efficiency of the vascular supply to the limb. Unfortunately, at the present time there exists no method which may be regarded as entirely satisfactory, since the circulation in the extremity depends upon the degree of arterial occlusion present, which is often considerable, and the development of adequate collateral channels. By no known method can either of these factors be successfully estimated at the present time. Palpation of vessels yields but meagre information and, if occlusion be present, there is little likelihood of locating it by this means. Tests depending upon colour changes in the limb, such as those of Matas[7] and Moskowicz[8] are also ineffective. Pachon's oscillometer does give evidence of occlusion and seems to be of some value in assessing the circulatory efficiency, but, as McKittrick and Root[9] point out, it gives no information as to the development of a collateral circulation. X ray examination of the vessels of the leg will reveal the presence of calcification, but this again is of little help in deciding the degree of circulation present. Theoretically the intraarterial injection of opaque substances, such as sodium iodide, as suggested by Brooks,[10] presents visual demonstration of the vascular supply of the limb in an X ray film, but it possesses the practical disadvantage that it is painful and it has been followed by a further decrease in the circulation with the subsequent development of gangrene in some cases.[11]

FIGURE VII. Posterior tibial artery in Case IX, showing "neovascularization" of the intima with marked narrowing of the lumen which has been displaced and almost obliterated by the new tissue in the intimal coat. ×10.

Other methods attempt to assess the circulation by means of the measurement of the temperature by a hypodermic thermocouple.[12] This is not always possible. Lastly, certain methods have been advocated, the

principle of which depends upon the time of absorption of intracutaneous wheals of measured small quantities of saline solution or histamine. This procedure, suggested first by Cohen and Stern,[13][14] awaits a satisfactory explanation of the underlying principle and is of no value in the presence of œdema. However, it has the advantage of extreme simplicity, and in a limited series of cases under my personal observation has yielded valuable help. Objections have been raised that in the border-line cases of circulatory failure there is the danger of introducing infection and in thus embarrassing the circulation further; but in selected cases it appears to be the most satisfactory method at present available.

## SYMPTOMATOLOGY.

Before the onset of frank gangrene, the presence of vascular changes may remain quite unsuspected until some exciting factor determines the onset of tissue death. In a certain number pain is a marked feature. The pain may bear a definite relationship to exercise and may resemble that of intermittent claudication. In more advanced cases the pain may be constant and agonizing, necessitating the use of opiates for its relief. As already mentioned, the occlusive process in the diabetic artery is a gradual one and, in general, the symptoms present no dramatic onset, but rather an insidious and slow progression. Occasionally, if thrombosis occurs in an already damaged artery, there may be a history of sudden excruciating pain in the limb followed by temperature and colour changes. Apart from pain, hyperæsthesia and subjective sensations of bursting and burning are not uncommon, and may give rise to great distress. Actual coldness, together with colour changes which are influenced by posture, may be observed if the circulation is seriously impaired.

FIGURE VIII. Posterior tibial artery in Case IX. Serial section following Figure VII, showing the origin of the new intimal vessels. × 10.

With the development of actual gangrene, pain is usually constant and severe. In the presence of infection symptoms of toxæmia or of septicæmia may be found and may be of such gravity as to demand urgent surgical intervention. The occasional absence of localized tenderness about an infected gangrenous area is at times deceptive, as the infection often spreads for some distance from the gangrene with little outward evidence of its presence. Likewise, the extent of any gangrenous patch

is never to be considered as an estimate of the underlying morbid process of arterial change.

## TREATMENT.

The ideal of any treatment should be prevention rather than cure, and a certain amount can be done in educating the diabetic in the risks and dangers of this disease.[15] The necessity for proper footwear, care of the feet and correct methods of dealing with ingrowing toe nails and corns are simple matters which are often overlooked. Regular exercise is beneficial and if, for any reason, an elderly diabetic patient is confined to bed, suitable exercises, such as those outlined by Buerger,[16] should be performed in order to help to maintain the circulation in the extremities.

The importance of the control of the diabetic state by diet and insulin cannot be over emphasized. It is well recognized that there is a far greater risk of the development of both arterial damage and gangrene in those patients who are not kept under a constant strict discipline. It is not uncommon to find that a patient with mild diabetes, either from ignorance or neglect, has failed to follow instructions for months or even years with apparently little harm, only to develop gangrene later, which possibly necessitates amputation of the leg.

Although gangrene is not at present preventible, its incidence can be lessened by the proper education of the patient in matters of diet and personal hygiene and by a knowledge of the penalties which will likely follow if these instructions be neglected. If the presence of vascular changes in an extremity be suspected, more energetic measures are advisable. Contrast bathing is a useful stimulant to the circulation if practised regularly. The judicious use of massage light and heat in the form of diathermy, is also recommended. Scrupulous care of the feet should be insisted upon and the avoidance of cold by the use of woollen stockings is essential. Some form of exercise, such as walking or Buerger's exercises, should be practised daily.

In the case of an established gangrene the treatment will depend upon the nature and the extent of the gangrene, the presence or absence of infection and the state of circulatory efficiency of the limb. Rest in bed is essential. If the gangrene is superficial and infection is not present, an attempt should be made to keep the area dry with spirit dressings, to which a mild antiseptic may be added, for example, picric acid 1% solution. Continuous warmth is also of value. A carbon filament lamp suspended from a cradle near the limb, which is suitably protected by blankets, is a useful method of applying heat. A line of demarcation may form and, if so, undue interference with the separation of slough is to be deprecated. The process of separation is usually a matter of some time. With gangrene affecting portion of the toe or toes, amputation may be resorted to if the circulation in the foot is satisfactory.

Measures to improve the circulation are often advocated. The value of exercises and warmth has already been mentioned. Operative pro-

cedures, such as arterial sympathectomy or the periarterial injection of alcohol, are seldom followed by any marked or permanent improvement. Occasionally they seem to turn the balance in favour of resolution, but not often. Lumbar ramisection, although followed by definite improvement of circulation in conditions where the vascular channels of a limb are patent, cannot be expected to benefit appreciably a limb which is barely existing on a collateral circulation.

Control of the diabetic state involves the most careful attention to diet, and insulin should be used to maintain the blood sugar at as low a level as possible in order to facilitate healing. In this regard, urine examination is often not reliable as a guide to the efficiency of treatment, since the renal threshold to sugar is frequently raised in these cases and a urine free from sugar may be found in the presence of a blood sugar content of 0·25% or even higher. Frequent estimations of blood sugar, therefore, are advisable as being the only reliable guide to the adequacy of control in the majority of these cases.

Failure of the conservative measures already outlined raises the question of amputation.

The indications for amputation in diabetic gangrene may be summarized thus:

(1) Spreading gangrene unaffected by other forms of treatment.
(2) Septicæmia or overwhelming toxæmia arising as a result of an infected gangrene.
(3) Failure of response to control of diabetes by diet and insulin because of the presence of severe infection.
(4) Persistent and intractable pain.

Before operation due consideration must be given to the site of election for amputation. It is important to recognize the fact that the extent of the visible gangrene is often no indication of the severity of the vascular changes in the limb. Some form of test, such as that of Cohen and Stern, gives a more reliable guide as to the level at which amputation is to be performed.

The pre-operative treatment should be directed to the prevention of shock and to the avoidance of ketosis. To this end the liberal administration of fluids and easily assimilated carbohydrate, together with adequate insulin, is advisable for two or three days if possible. Fifty grammes of carbohydrate in the form of Benger's food, gruel, arrowroot or glucose in fruit juice, together with 25 to 30 units of insulin, can be given three or four times a day.

The choice of anæsthetic is also of importance. Spinal anæsthesia is to be preferred, provided that measures are adopted to prevent any alarming drop in blood pressure. Failing this, nitrous oxide or ethylene with oxygen should be used.

In view of the impoverished vascularity of the limbs, the use of a tourniquet is inadvisable, even for a short period, and speed, together with a minimum of trauma to the tissues, offers the best chance of a

successful result. Flaps should be of adequate size to prevent tension on the suture line and any undue traction on the flaps or soft tissues during operation is to be avoided, as this may determine further gangrene in the stump.

Following operation, control of the diabetic state is of the utmost importance and the blood sugar should be maintained at almost the hypoglycæmic level[17] in order to present the most favourable circumstances for satisfactory healing.

## APPENDIX.

### Tests of Circulatory Efficiency.

*The Matas Test.*—The leg is elevated for five minutes. An elastic bandage is then applied from the digits proximally as far as possible, and left in position for five minutes. The bandage is then removed and the main artery is compressed digitally. A wave of hyperæmia spreads down the limb and progresses in proportion to the development of the collateral circulation. If this is inadequate, the line of hyperæmia will stop at a definite level which is considered as the site of election for amputation.

*The Moskowicz Test.*—The leg is elevated for five minutes. An elastic bandage is applied as before and allowed to remain in position for five minutes. The bandage is then removed and the reactionary hyperæmia is observed without any interference with the main artery. Moskowicz considers the site of election for operation to be at the lower border of the hyperæmic zone thus produced.

*The Test of Cohen and Stern.*—By means of a tuberculin syringe and a fine needle, 0·2 cubic centimetre of a normal saline solution is injected intradermally so as to produce a wheal. Injections are made at the base of the great toe and at intervals of three or four inches up the foot and leg. The disappearance time of these wheals, as estimated by palpation, is noted, the normal time of disappearance being at least sixty minutes. In the presence of arterial occlusion the level at which the wheal remains for this length of time is considered as the site of election for operation. The test is of no value in the presence of œdema.

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# RADIOTHERAPY AS THE TREATMENT OF SELECTION IN FOUR TYPES OF BONE TUMOURS.

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There are four types of primary bone tumours which are definitely proved to be radio-sensitive, not in a palliative way as is still the opinion held by many of our colleagues, but from the curative point of view. They are as follows in the order of their radio-sensitivity: (i) Ewing's sarcoma; (ii) giant cell tumours (myeloid sarcoma or myeloma); (iii) the highly

Figure I.

Figure II.

cellular fibro-sarcomata or fibro-myxo-sarcomata; (iv) osteogenic sarcoma of certain types, for example, chondral forms.

They can all be diagnosed radiographically. Out of the eight types of solitary bone tumours the above four are radio-sensitive; therefore a course of X ray therapy is a valuable aid to diagnosis. If there is no definite improvement in six weeks, X ray treatment should be discontinued. This may be called the radiotherapeutic test. On no account is there any necessity for biopsy. Not only is it unnecessary, but it is entirely wrong procedure if radiation is the treatment of selection.

## EWING'S SARCOMA.

Until lately the treatment of Ewing's sarcoma has always been surgical operation, but now authorities such as Ewing himself and Bloodgood definitely state that radiotherapy is the only correct treat-

FIGURE III.

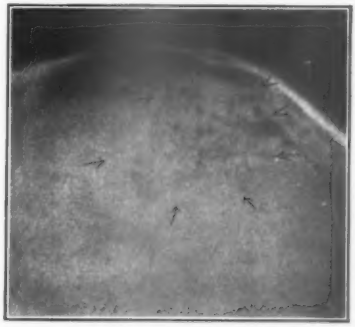

FIGURE IV.

ment. Ewing's tumour occurs one-quarter as frequently as osteogenic sarcoma and mainly in the first two decades of life. The primary tumour occurs most frequently in tibia or femur and always gives rise to metastases. Blood counts invariably reveal a leucocytosis. Fracture is rare. The regional lymph glands are enlarged in

FIGURE V.

FIGURE VI.

one-third of the cases; therefore mistaken diagnosis is frequent and much valuable time is lost. Radiographically there is a fusiform widening of cortex with narrowing or obliteration of medullary cavity.

CASE I.—N.P., aged twenty-eight years, first complained of pain in the right knee in 1923. In January, 1929, he noticed a lump on the inner side of the right knee. Radiographically a sarcoma was diagnosed (see Figure I). The tumour was

incised and partly removed, and microscopical examination revealed a Ewing's sarcoma. This was confirmed by its extreme radio-sensitivity to X radiation (see Figure II). During treatment to the primary tumour pain developed in the right hip joint. Six months later a large tumour in the left parietal region was observed. Radiograms revealed secondary deposits in neck of right femur (see Figure III), left parietal region (see Figure IV), lateral margin of fourth lumbar vertebra, upper third of left humerus and in left scapula. These were all treated and proved as radio-sensitive as the primary tumour. All areas are now radiographically and clinically healed (see Figures II, V and VI).

On September 4, 1930, the patient developed enlarged lymphatic glands on both sides of the neck, with a secondary nodule in the right mastoid, and a tumour in upper outer quadrant of left breast. These were treated and disappeared. On March 12, 1931, a similar tumour developed in the right breast which also resolved under treatment.

FIGURE VII.

FIGURE VIIA.

1. The only disability now present is some slight stiffness of the right knee joint which is probably due to the original surgical interference.

2. The patient now leads a normal life and has gained 9·4 kilograms (one and a half stone) in weight since commencing treatment.

3. No mental or nervous symptoms developed in spite of the extensive lesion in the parietal bone.

4. There are no secondary deposits at present and it was noticed that the interval between the appearance of the metastases gradually became longer, and the metastatic areas smaller as treatment progressed. The prognosis is therefore definitely more favourable than it was at the commencement of treatment.

## GIANT CELL TUMOURS.

Giant cell tumours (myeloid sarcoma or myeloma) always occur in an epiphysis. The order of selection is (i) lower end of radius, (ii) lower end of femur, (iii) upper end of tibia, *et cetera*.

Signs and symptoms practically always include trauma, pain, tumour and fracture. They perforate the bony shell in 60% of cases, and cause fracture in 14%.

Radiographically there is a globular, trabeculated, rarefied a symmetrical expansion of bone, enlarging at the expense of the cancellous bone and the diagnosis is unmistakable to the trained radiologist. The differential diagnosis must be made from simple bone cyst, but as the latter occurs only in the metaphysis, there should be no confusion.

The following five cases typically show the results of radiotherapy with and without surgical interference.

CASE II.—R.T., a male, aged forty-five years, an electric drill worker, complained of pain, swelling and tiredness of the right wrist. A radiogram on October 25, 1928, revealed a fusiform, trabeculated, cystic condition of the lower end of the ulna about 6·25 centimetres (two and a half inches) in length, involving the articular surface of the ulnar-carpal joint (see Figure VII). Curettage was performed on December 10, 1928. X radiation was given from March 25, 1929, to May 13, 1929. And again, because healing was not as complete as was expected (see Figure VIIA), I was asked to give a further course. This was done from July 12, 1929, to August 12, 1929.

FIGURE VIII.

FIGURE IX.

At present the patient has a fairly good clinical result, but there is still slight pain when working (see Figure VIII). Strong bone has been deposited in the periphery of the tumour, but there has not been the even deposition of bone throughout the lesion.

The central area of the tumour has not regenerated owing to the permanent removal of osteoblastic tissue.

CASE III.—M.B., a female, aged thirty-two years, in 1918 first noticed on the medial side of the left knee a swelling which was removed by surgical operation in 1925. Later a radiogram was taken and showed a double lesion of a typical

myelomatous condition of both the lower end of the femur and the upper end of the tibia (see Figure IX). A full course of deep therapy was given in 1925 through a filtration of 0·5 millimetre of copper only. In 1927 the patient had two further courses of X ray therapy with improvement, but the irradiation was filtered through only 0·5 millimetre of copper. Early in 1929 lesions appeared almost healed. However, towards the end of 1929 it was seen that areas in both femur and tibia were still active (see Figure X). Again a course of X radiation was given through only 0·5 millimetre of copper.

In October, 1930, a radiogram showed marked increase in activity of growth in both femur and tibia, the latter breaking through the periosteum. A course of X ray therapy was given through two millimetres of copper, and the result five months later is shown in Figure XI, where there is seen a marked improvement in

FIGURE X.

FIGURE XI.

both lesions as indicated by the extreme sclerosis of the bony tissue around the central cavities. The clinical findings are in accordance with the skiagram.

1. Particularly interesting in this case are the double lesions co-existing in the epiphyses above and below the knee joint.

2. In 1925 deep X ray therapy was in its infancy and the value of heavy filtration was not known.

CASE IV.—A case very similar to Case III was that of a man, S.R., aged forty-two years, who commenced treatment in 1925 after curettage of a myeloma in the lower end of the femur. This patient had practically the same treatment and ran practically the same course until, during the last few months, when he was given his dosage through higher filtrations of copper (two millimetres), and has now reacted well.

CASE V.—M.H., female, aged thirty-three years, was a tennis player and felt weakness in the right wrist whilst playing on January 12, 1930. She treated the wrist for a sprain until March, 1930, when the wrist became swollen, tender, red and painful. A radiogram taken on April 10, 1930 (see Figure XII) revealed a myeloma. The radiological report was interesting: "Large area of destruction in lateral aspect of lower end of radius with definite expansion of the bone—with some trabeculation—appearance is that of a giant cell tumour, but a little infiltration at its upper margin suggests that it is not quite so benign as these tumours generally are." Treatment by deep X ray therapy was commenced on April 11, 1930, and was concluded on May 6, 1930. On June 17, 1930, the wrist was normal clinically and the radiogram showed that healing was taking place. The present condition is illustrated in Figure XIII, which shows uniform deposition of new bone, and the radius has practically returned to its normal size and shape.

FIGURE XII.

FIGURE XIII.

1. In this case there was not any surgical interference of any sort which may reasonably account for the perfect healing.

2. The patient received only one complete course of X radiation, but it was through one millimetre of copper, and, despite the narrow transverse section of the part treated, three areas of the wrist joint were given the maximum amount of irradiation.

FIGURE XIV.

FIGURE XV.

CASE VI.—C.P., a female, aged fourteen years, had X radiation for a myeloma of the end of the right femur (see Figure XIV) during August, 1926. No biopsy was performed. A radiogram was taken in January, 1931, and revealed a healed lesion. On examination there was only a very slight thickening

on the medial side of the lower end of the femur and all joint movements were perfect (see Figure XV).

Of the five cases of myeloma here quoted, the two last show the best clinical and radiographic results. Neither of these patients was subjected to any form of surgical operation.

## THE HIGHLY CELLULAR FIBRO-SARCOMATA OR FIBRO-MYXO-SARCOMATA.

CASE VII.—J.H., a male, aged eighteen years, on February 20, 1930, was wrestling. His "arm went" and the pain was severe. A radiogram revealed a sarcoma in the middle third of the right humerus with a complete pathological fracture (see Figure XVI). Immediate amputation was advised, but this the patient refused. He consented, however, to a biopsy, which was performed on March 1, 1930. The pathologist reported a "highly cellular fibro-myxo-sarcoma."

FIGURE XVI.

FIGURE XVII.

X radiation was given from March 20, 1930, to April 1, 1930. A radiogram taken on June 17, 1930, revealed a firm union and much sclerosis in the outer parts of the lesion.

A second course of irradiation was given from September 10, 1930, to September 16, 1930, because some signs of activity were still present in the central part of the tumour. Radiograms taken at end of last year revealed excellent bony union with the fragments in perfect alignment. There was well marked sclerosis (see Figure XVII) of the cortical bone. The central portion has not yet quite healed, but the patient is now so well that he refuses to report for further radiographs.

Amputation not only carries with it the ordinary surgical risk, but the literature shows that it is of little ultimate avail. Radiation, on the other hand, is not fraught with danger, and even if the end results be the same, which with our recent knowledge appears unlikely, the intervening years of economic value justify this method of procedure.

CASE VIII.—P.E., a male, aged nineteen years, was admitted to hospital after slight injury to the left femur, having complained of pain and swelling of the

left knee for six months. A radiographic examination on March 3, 1929, revealed cystic absorption of the centre of the shaft of the femur just below the neck, with pathological fracture and impaction. The diseases affected the bone as far up as the head. The surgeon in charge of the patient decided on pre-operative irradiation followed by curettage and post-operative irradiation as well. A full course of X ray therapy was given from May 30, 1929, to June 20, 1929, and on June 28 curettage was performed. Histological examination showed that the lesion was composed of "fibro-cellular tissues in which some small areas of bone were present." There was no hæmorrhage and only a very occasional collection of giant cells. The appearance suggested fibro-sarcoma. Post-operative radiation was given from June 28, 1929, and from August 12, 1929, but on April 8, 1930, there was still no union. The present condition is shown in Figure XVIII.

Comparing this with the previous and similar case in which the fracture united in six weeks, it appears that combined curettage and over-radiation permanently destroyed the osteoblastic cells, thus preventing the X rays stimulating the usual normal callus formation.

FIGURE XVIII.

## OSTEOGENIC SARCOMA OF CERTAIN TYPES.

CASE IX.—M.G., a male, aged fifteen years, complained in December, 1929, of pains in the left thigh, knee and hip. A radiogram showed that a tumour was growing from the left *tuber ischii*. Radiologically this tumour was composed of chondromatous and osteomatous tissue. The bony portions of the growth were interspersed amongst the cartilaginous areas. Diagnosis of a chondral type of osteogenic sarcoma was made (see Figure XIX). No biopsy was performed. A full course of radiation was given during December, 1929, anteriorly and posteriorly to the growth. Radiograms were taken at intervals to September, 1930, when there was seen a suspicious roughening of the ischium. Although it could not be said that there was any definite recurrence, a further course of radiation was given, and the apparent perfect result is shown in a radiogram taken in April, 1931 (see Figure XX).

This case is included particularly to demonstrate that the science of radiology has reached a stage at which surgical biopsies are unnecessary for definite diagnosis, and that there is a type of osteogenic sarcoma which does resolve under irradiation.

## TECHNIQUE.

The best results are obtained with two essentials, a heavy filtration of copper and a high voltage. In this series of cases treatment administered during the last twelve months has been as follows: 200 to 220 kilovolts, a filter of one to two millimetres of copper, 45 to 50 centimetres distance, radiation being given through as many ports of entry as the anatomical area would allow. The actual dose measured by

a dosimeter is always 3,000 to 5,000 Röntgen units (Solomon) through each port of entry.

## CONCLUSIONS.

1. The justification of irradiation alone in the above forms of bone tumour lies in the fact that in the past the end results after operative treatment have not been very successful.

2. Whether operation be amputation, local removal or curettage, the patient is subjected to operative risks and must remain for a period in hospital.

3. In amputation of a limb there is immediate economic loss quite apart from any other factor. The risk of metastases is increased and a surgeon cannot go on amputating metastases.

4. In local removal the possibility of resultant fracture is again increased, and the statements made regarding metastases still hold.

5. In curettage, which includes biopsy, the radiologist is hampered by the removal of normal bone-forming cells which are necessary if results are to be obtained by radiation.

FIGURE XIX.

FIGURE XX.

6. Assuming that the first consideration is always the patient, he should be given the chance of a form of treatment which causes no pain, no extra loss of work, no stay in hospital, no economic disadvantage, and, above all, no risk of life, and which with modern knowledge certainly offers no less chance of cure than surgical operation. On the other hand, it must be realized that, although we consider that X ray therapy in these cases is the treatment of choice, unless radiation is of sufficiently short wave length, and is so filtered that it approaches a beam as homogeneous as present apparatus will allow, it is of little value and is comparable to inefficient surgical operation.

## Surgical Technique.

# A METHOD OF FIXATION OF THE HIP JOINT BY MEANS OF AN EXTRAARTICULAR BONE GRAFT.

By Hugh C. Trumble,
*Melbourne.*

It is proposed to describe in this paper an operation designed to effect fixation of the hip joint by means of an extraarticular bone graft. In the first place the need for some such procedure will be discussed, following which the author's method will be described. Lastly, notes of cases in which this operation has been undertaken will be appended.

### The Need for Operation.

Tuberculosis of the hip joint almost invariably results in extensive destruction of the joint and ultimately in limitation of movement. Sometimes bony ankylosis ensues, and this may be looked upon as a most satisfactory state of affairs, provided that the position of the limb is correct. Far more frequently ankylosis is by fibrous tissue, and often a slight degree of movement at the hip remains. It is then a matter of extreme difficulty to determine whether the inflammatory process is at an end or merely quiescent. If the latter, there is ever present the danger of recrudescence of the disease locally or spread to some other part as a result of blood-borne infection. Further, fibrous ankylosis is not a stable condition and when retaining apparatus is abandoned the limb tends to pass into a position of adduction, flexion and internal rotation at the hip joint. In addition, there is often pain which is probably due to stretching of the fibrous tissues.

In view of the state of instability and uncertainty associated with fibrous ankylosis, it would seem to be reasonable to endeavour to alter matters so as to attain as nearly as possible the condition seen in bony ankylosis, which is characterized by stability, freedom from pain and relative freedom from the danger of

Figure I. Skiagram of a hip joint showing extreme destruction of the head and neck of the femur. The interval between the tuberosity of the ischium and the shaft of the femur, normally about 3·75 centimetres (one and a half inches), has disappeared, and a false joint has been formed between the bones.

recrudescence of the disease. Further, it is probable that firm fixation may influence favourably the inflammatory focus and help to bring about bony ankylosis.

### The Time to Operate.

It is unwise for several reasons to resort to operative measures whilst the inflammatory process is still active. In the first place there are frequently other foci of disease which may not have declared themselves. The patient should be put at rest in bed for a long period, during which repeated examinations of the whole body and particularly of the respiratory and genito-urinary systems must be carried out. If after some months no evidence of disease has been found apart from that in the hip joint, it may be assumed that there is no other progressive lesion to contraindicate operation. Secondly, the risk of dissemination of the infection or local reactivation by the manipulations associated with operation is by no means negligible. The risk is distinctly less after the passage of a period of time during which the health of the patient has been improved by means of careful management and the disease has become quiescent. During this period the limb is gradually brought into the ideal position for ankylosis. Thirdly, it is impossible to prophesy how the process will end in any particular case. Satisfactory ankylosis by bone may result spontaneously, and all patients should be afforded a chance to work out their own salvation before the surgeon actively interferes.

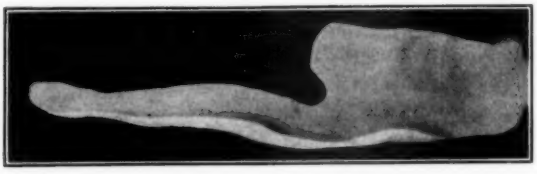

FIGURE II. Plaster bed used to support the hip in disease or after operation. In this case the bed was moulded over a "dummy" dressing so as to contain a recess for the accommodation of the post-operative dressing.

Summarizing the above, it may be stated that operation should be resorted to only after a period during which adequate conservative treatment has been carried out, and after it has been established with reasonable certainty that there is no other important focus of active disease. In addition, it must be provided that the inflammatory process is apparently at an end or at least quiescent, and that ankylosis, if present, is not bony. The period mentioned should seldom be less than one year and often is much more. It is assumed that no other disease is present which would contraindicate operation.

FIGURE III. Patient lying in the plaster bed. The splint greatly facilitates transportation, and provides excellent support.

### The Plan of Operation.

For many reasons which need not be discussed, it is unwise to attack the affected joint directly. Hence some form of extraarticular fixation must be devised. In the method employed by the author a stout free bone graft is inserted between the tuberosity of the ischium and the shaft of the femur just below the lesser trochanter. Such a graft is very well placed to resist adduction of the femur and may be expected to act to some extent as a weight-bearing column. In this respect it should be noted that it passes from the femoral shaft directly into the

normal weight-bearing column of the pelvis which is used in sitting. Probably the graft would render better service in respect of weight transmission if it were placed more obliquely than has been done by the author, and in future it is proposed to make this alteration. Obviously any strain taken by the new column will mean so much less upon the old diseased column. Lastly, movement at the hip joint is prevented.

### Anatomical Considerations.

In the normal adult the distance between the tuberosity of the ischium and the shaft of the femur in the region of the lesser trochanter is between 2·5 and 5·0 centimetres (one and two inches). When the head of the femur and acetabulum are being destroyed the lesser trochanter moves upwards and medially, and the interval is lessened. In one of the author's cases of tuberculosis of the hip joint in which the head and neck of the femur were entirely destroyed, the interval was so reduced that the bones came in contact and an artificial joint was formed (see Figure I). In the gutter between the tuberosity and the femur lie the greater and lesser sciatic nerves. The graft must be placed so as to avoid pressing on these. There are no other important structures to interfere with the placing of the graft in position.

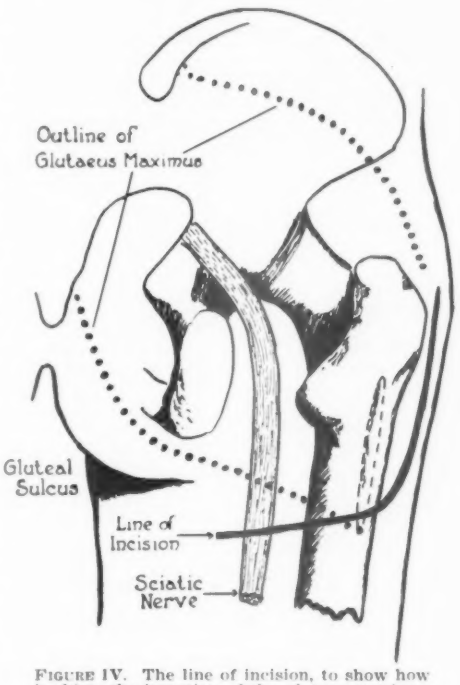


FIGURE IV. The line of incision, to show how it skirts the insertion of the *gluteus maximus* muscle into the *fascia lata* above and the femur below, and crosses the middle line of the thigh below the level of the gluteal sulcus. The limits of the *gluteus maximus* muscle are represented by the dotted line, the osseous insertion by the area enclosed in the interrupted line on the femoral shaft.

### Pre-Operative Preparations.

Some time prior to the day fixed for operation a plaster bed with an extension reaching to and including the foot is made, great care being taken to place the limb in the best possible position for ankylosis, that is, slight flexion at hip and knee and very slight abduction at the hip. A large dummy dressing is applied over the area to be operated upon, so that the plaster will accommodate the post-operative dressing when the time comes. The author's method of construction plaster beds and other plaster splints is described in *The British Journal of Surgery* of October, 1931. If the limb cannot be placed in good position and has resisted all conservative measures such as traction, it may be necessary to administer an anæsthetic and forcibly to correct the deformity. The patient is kept lying in the plaster bed for some days or weeks in order to accustom him to its support. When fixation at the hip is firm in good position the need for post-operative support such as the above is not so pressing. The immediate pre-operative preparation of the patient and the skin *et cetera*, need not be described.

Figures II and III depict a plaster bed of the type used to support the hip before and after operation.

**Technique of Operation.**

The patient lies prone suitably supported. An incision is made commencing just above the greater trochanter and passing downwards in the line of the shaft of the femur for about 7·5 centimetres (three inches), after which it is carried medially in a curve across the thigh below the level of the gluteal fold (see Figure IV). This incision is well away from the perineum. The *fascia lata* is incised throughout the length of the incision. Care must be taken not to injure the lesser sciatic nerve which lies immediately under the deep fascia at the lower extremity of the incision. A finger is inserted under the fascial insertion of the *gluteus maximus* in the upper part of the vertical limb of the wound and helps to display the osseous insertion in the lower part. This is divided from above downwards with a scalpel, enough being left attached to the bone to permit of suturing later. The whole flap, consisting of skin, subcutaneous tissue, deep fascia and *gluteus maximus*, is then drawn up and medially. A little blunt dissection easily displays the femur in the region of the lesser trochanter, the tuberosity of the ischium with the origin of the hamstring muscles and the great sciatic nerve lying on the sulcus between. The lesser sciatic nerve is carried up on the deep surface of the *gluteus maximus*. A broad chisel (the author uses an ordinary short-handled carpenter's chisel with a blade 2·5 centimetres or one inch wide) is then driven deeply into the tuberosity so as to split off the posterior portion. The blade of the chisel should be flat on the shaft of the femur whilst this is done, so as to insure that the graft will slide easily into the split in the tuberosity. Before the chisel is withdrawn from the tuberosity the handle is elevated, the small posterior fragment thus being levered away from the main mass so as to provide an open cleft for the reception of the graft.

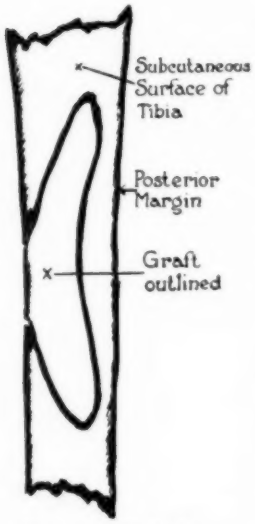


FIGURE V. Method employed to obtain a curved graft. The centre of the graft is at the anterior margin of the subcutaneous surface of the tibia, and is very thick and strong. When it is unnecessary to use a curved shape a broad straight flat graft is cut from the subcutaneous surface.

Next, an area on the postero-medial aspect of the femur a little below the level of the tuberosity of the ischium is selected and cleared. The uppermost part of the insertion of the *adductor magnus* is divided. A trap-door about 18 millimetres (three-quarters of an inch) from above down and a little less from side to side is then cut from the postero-medial aspect of the shaft. The bone is usually soft from disuse and easily penetrated by a chisel, but if difficulty is experienced a small drill may be used to aid in the separation. The bone flap is cut through on three sides (upper, lower and medial) and then levered up so as to break along the fourth or lateral side which is situated approximately in the posterior mid-line of the femoral shaft. Thus a flap of bone hinged on the periosteum at its outer edge is raised, a hole being left through which the graft may be passed into the medullary cavity of the shaft. It is important that the outer edge of the trap-door should not pass much beyond the middle line of the shaft as seen from behind, as fixation of the graft depends on the overhang of the bone cortex lateral to the flap. Next a piece of malleable sheet metal or a probe is taken and bent or cut so as to afford a pattern for use in shaping the graft. When in position it should pass well into the cleft in the tuberosity and as far into the medullary cavity of the femur as it will go. It may be necessary to bend the probe slightly so as to arch over

the great sciatic nerve. A stout graft is then cut to pattern from the middle third of the subcutaneous surface of the tibia of the sound limb (as a rule). A method of obtaining an arched shape is shown in Figure V. The ends of the graft are cut to a wedge shape with a chisel.

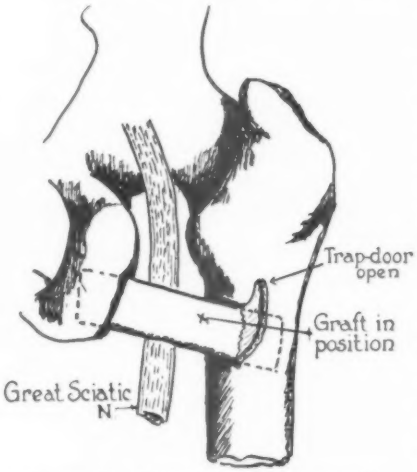


FIGURE VI. Diagrammatic representation of the graft in position, one end being inserted into a cleft in the tuberosity of the ischium, the other into the medullary cavity of the femur through a trap door opening. The trap door hinged on the periosteum at its lateral margin is shown open.

One end of the graft is then inserted into the cleft in the tuberosity of the ischium and driven in until the other end may be manipulated into the hole in the femur. Then the graft is driven in the opposite direction so that its outer end becomes firmly caught under the outer margin of the femoral opening. In order to effect this a chisel is used to transmit the blows of a mallet to the graft, its sharp edge engaging in the surface of the bone and preventing the tool from slipping. When properly in position the graft is very firmly fixed (see Figures VI and VII). The bone flap is then swung back over the graft and fixed by means of catgut sutures, and the wounds are repaired *secundum artem*. Dressings are placed over the wounds and securely fixed. The plaster bed is then placed in position on the patient and, thus supported, he is rolled over and transported to the ward without any fear of dislodgement of the graft.

### Post-Operative Management.

The wounds are dressed the day following operation, after which the patient is not moved for ten days or so, when the skin sutures are removed. He is then left undisturbed on the plaster for a month or more, and may be allowed up on crutches in about three months.

### Case Reports.

CASE I.—A boy of sixteen years was admitted to the Austin Hospital in October, 1928. Six years before this he had been treated for tuberculosis of the right hip joint and an abscess was opened. He got about for some years until shortly before admission, when the trouble recurred. After nearly two years of conservative treatment at the above hospital the limb was in moderately good position and the boy's general state of health was excellent; but clinically there was still slight movement present at the hip joint and a skiagram showed that the disease, though quiescent, was not cured. Operation was undertaken in October, 1930. Convalescence was uneventful. Some weeks later an abscess developed

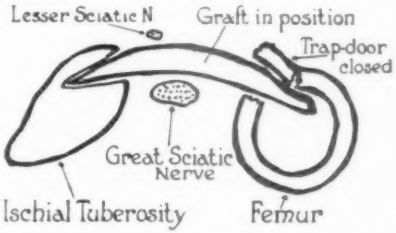


FIGURE VII. Diagrammatic representation of a horizontal section through the graft in position to show how it arches over the great sciatic nerve and the manner in which the ends are cut to a wedge shape to facilitate introduction. Both ends are firmly gripped and cannot get out of position. The trap door in the femur is shown replaced. The sciatic nerves are shown separated by the graft.

and burst through the old scar. The sinus has since healed and the boy is up and about. There is no appreciable movement at the hip. A skiagram taken in June, 1931, shows that the graft has fused well with the ischium and femur, and healing has progressed well at the seat of inflammation (see Figure VIII).

CASE II.—A girl of nineteen years was admitted to the Austin Hospital in November, 1929. Ten years before this she had been treated for tuberculosis of the cervical spine, which had since given no trouble. Six years previously

FIGURE VIII. Skiagram of the hip region eight months after operation (Case I). Note that the graft is solidly united to the ischium and the femoral shaft. Healing is well advanced at the site of infection. In this and the subsequent figures it may be seen that the grafts are placed so as to prevent adduction and transmit weight to the "sitting" column of the pelvis, thus sparing the diseased "standing" column.

she was confined to bed with hip disease on the right side. She became well enough to get about until eight months prior to admission. After about fifteen months' conservative treatment her general health was excellent, but there was still movement at the hip joint. A skiagram showed that the inflammatory process was still active. Operation was undertaken in March, 1931. Convalescence was uneventful. In June, 1931, there was no appreciable movement at the hip joint, and the patient stated that she had a feeling of security which was not present before operation (see Figure IX).

CASE III.—A woman, twenty-seven years of age, was admitted to the Austin Hospital in November, 1924. During the previous four years tuberculous infections of the spine, glands of the neck, sterno-clavicular articulation and right hip joint had appeared. Conservative treatment was persisted in for over six years, during which time the patient's general health improved greatly and the various foci apparently cleared up, with the exception of the hip. At this joint there was still slight movement associated with pain. Operation was undertaken in April, 1931. Convalescence was uneventful. Figure X is a skiagram of the hip showing the graft in position. In November, 1931, there was no movement appreciable clinically at the hip joint, and the patient was up and about on crutches.

FIGURE IX. Skiagram of the hip joint three months after operation (Case II). Fusion of graft with ischium and femur is good, but not so advanced as in Case I.

## Summary.

A method of fixation of the hip joint by means of an extraarticular bone graft is described. It is pointed out that tuberculosis of the joint often results in fibrous or partial ankylosis, which is not a satisfactory state of affairs, being characterized by instability, pain and a tendency to recrudescence of the disease. It is thought that firm fixation tends to eliminate these undesirable characteristics.

Operation should not be undertaken whilst the disease is still active, or in the presence of other foci. A period of a year or more during which careful conservative treatment is carried out, should elapse before resort is had to surgical intervention.

At operation a stout free graft from the tibia is placed in position between the tuberosity of the ischium and the shaft of the femur a little below this point.

The method of approach to the area is described, as also the way in which the bone graft is locked in position. The graft is well placed to resist adduction at the hip, prevents movement and probably transmits much of the weight of

FIGURE X. Skiagram of the hip joint two months after operation (Case III). The stout graft is in position, but not yet well fused with the ischium and the femur.

the body to the femur, thus lessening the strain upon the damaged joint. Probably the firm fixation influences favourably the inflammatory process and helps to bring about bony ankylosis.

Reports of three cases treated by the method are included.

### Addendum.

In January, 1932, there was no evidence of fracture or absorption of the grafts in any of the above recorded cases. Clinically fixation is firm, and skiagrams show a satisfactory state of affairs.

# PROSTATIC TECHNIQUE.

By H. B. DEVINE,
*Honorary Surgeon, Saint Vincent's Hospital, Melbourne.*

ANY technical procedure which will improve the chances of saving the aged and debilitated prostatic patient must be considered worthy of report.

In the operation of prostatectomy there are two serious complications which occur from time to time. These are bleeding at the time of the operation or soon after, and contraction and obstruction of the internal urethral orifice of the bladder which may take place any time after the prostatic cavity has healed. It is obvious that it should be possible to avoid these accidents, and that they would not happen if the prostate were dissected out, the vessels tied and the raw surface covered with mucosa; that is, if the removal of the prostate were made on the same principles as the removal of a tumour in the accessible regions of the body. The proper surgical treatment of the prostatectomy wound should also prevent the dreaded secondary hæmorrhage and its dangers. The problem is, then, one of surgical access to the prostate; for if the prostate can be adequately exposed the principles that I have indicated can be carried out by any surgeon with average skill.

### Surgical Access to the Prostate.

The difficulties in properly exposing the prostate are: (i) When empty the cavity of the bladder is collapsed by the pressure of the contents of the peritoneal cavity and there is no space in which to work; (ii) there is difficulty in illuminating the prostate in the collapsed bladder; (iii) the prostate is inaccessibly situated under the pubic arch; (iv) bleeding in the confined space of the folded bladder very soon prevents proper vision.

The way, then, to get good access to the prostate should be as follows: the bladder should be distended as it is when it is full of water; the fundus of the bladder should be pushed up into the abdomen so as to stretch the base of the bladder and so pull the prostate out from under the shelter of the pubic arch and remove folds from the base; the bladder should be illuminated with boilable lights; a continuous suction should be provided in order to remove blood.

The method of prostate approach (illustrated in Figure I) provides for these facilities. The retractors 1 and 2 and 3 are spoon-shaped retractors (see also Figure II, which shows the shape of "spoon retractors"), so bent and shaped that when inserted and fixed to the frame they completely unfold the bladder and push it into a position of distention. Numbers 1 and 2 retractors have small lamps fitted into the middle of the spoons. The spoons, therefore, serve both as reflectors and retractors. There is an advantage in having two lights because the illumination is better and because, as a rule, the two lamps do not become coated with blood at the same time. These lamps are the ordinary little lamps which are sold in the shops for flashlights and, with their leads, can be boiled for ten minutes or longer. Sometimes a small retractor is necessary at 4, as in Figure III. This acts as a *point d'appui*.

With the patient in the Trendelenburg position there is plenty of room in the thus distended bladder for the blood to flow away from the prostate into the spoon retractor 2, where it is collected by a suction tube fixed to the frame.

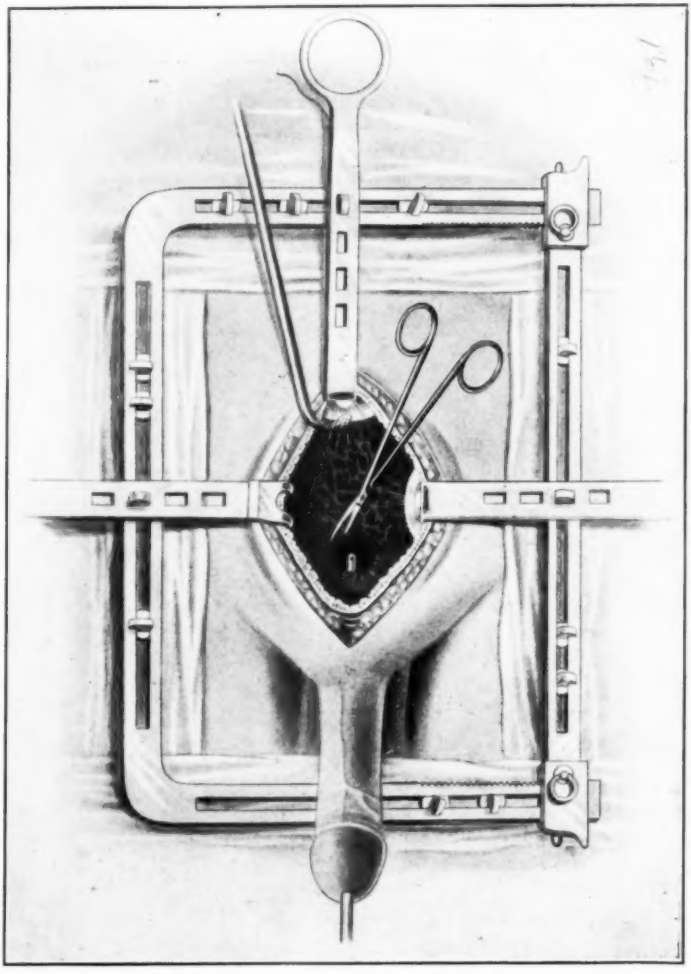

FIGURE I. Showing method of exposing the prostate.

The prostate is removed by first making a circular incision around the internal urethral orifice, then dissecting out the prostate, starting on its posterior surface. As vessels bleed they are clamped or tied.

After the removal of the prostate, the mucous membrane in the vicinity is dissected up, trimmed and stitched to the prostatic bed.

### Post-Operative Technique.

There are many methods of post-operative treatment of a patient after prostatectomy. In all these, urine remains in contact with the prostatic and

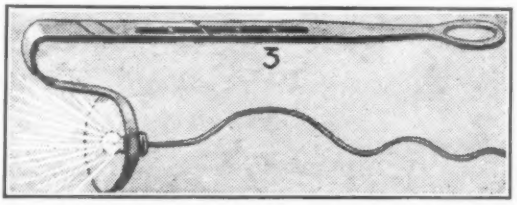


FIGURE II. Showing the shape of the illuminated "spoon" retractors.

abdominal wounds, because they all depend on the principle of collecting the urine after it has overflowed from the bladder. These methods suffer from the disadvantage that the continual contact of even normal urine with a wound inter-

FIGURE III. Showing the bladder of a cadaver exposed with retractors to show how the base of the bladder is stretched. It also shows how the illuminated retractors do not come into the operation area; they cannot be seen in the photograph. An arrow points to the internal urethral orifice.

feres with the processes of healing. Ammoniacal urine, which results from stasis of urine and the action of urea splitting organisms is still more injurious to the healing process and may cause cystitis, necrosis of fat and even sloughing of the tissues, especially if they are senile or devitalized. Ammoniacal urine is

not an infrequent sequence of prostatectomy. Therefore, in the post-operative treatment of prostatectomy the object should be to have urine as little as possible in contact with the wounds. This can be accomplished by a post-operative technique in which a continuous suction keeps the bladder free from urine.

In Figure IV such a method is illustrated. A rubber tube A, which has many perforations in its lower end, is inserted as far as the cavity from which the prostate was removed. In this a metal tube B of small calibre with a perforated aspirating end is lowered till it is just touching the mucosa. This tube is kept in position by a set screw on the plate C. In the upper end of the tube A

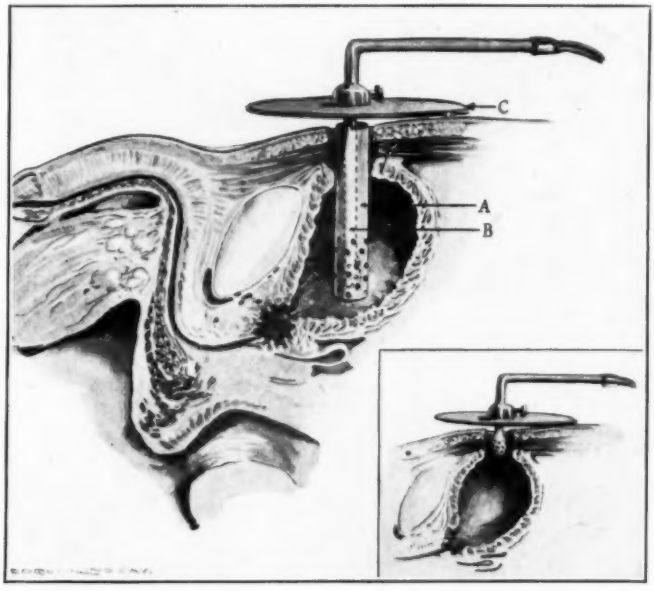


FIGURE IV. Showing apparatus for the technique of continuous aspiration of the bladder after prostatectomy. (This illustration has appeared in article contributed by the author to *Surgery, Gynecology and Obstetrics*, August, 1926.)

a slot is cut as far as the wall of the bladder. This is done to connect the space of Retzius with the tube.

The suction is provided by a water pump attached to a service tap, and a very little flow of water is sufficient. After seven or eight days, when the space of Retzius is sealed off, the aspirating bulb is elevated to a point in the wound of the abdominal wall just external to the opening in the bladder (see inset, Figure IV).

By this method it is possible to keep the bladder free from urine till granulation tissue forms and serves as a protection for the prostatic wound and to maintain the patient dry and comfortable till the wound in the bladder has completely healed. The great quantity of air which is aspirated over the wounds also helps to keep them dry, clean and healthy.

Even in the senile patient with defective renal function and tissues of low resistance, this method of continuous aspiration gives clean odourless wounds with no infection, sloughing wound edges or phosphatic deposits. In routine use for over fifteen years it has been a great advance in our prostatic technique.

# Case Reports.

## CHORDOMA.

By E. T. Cato,
*The Alfred Hospital, Melbourne.*

The patient, J.J.F., was aged thirty-five years; he had been married for three and a half years and had no family. His occupation was that of carrier;

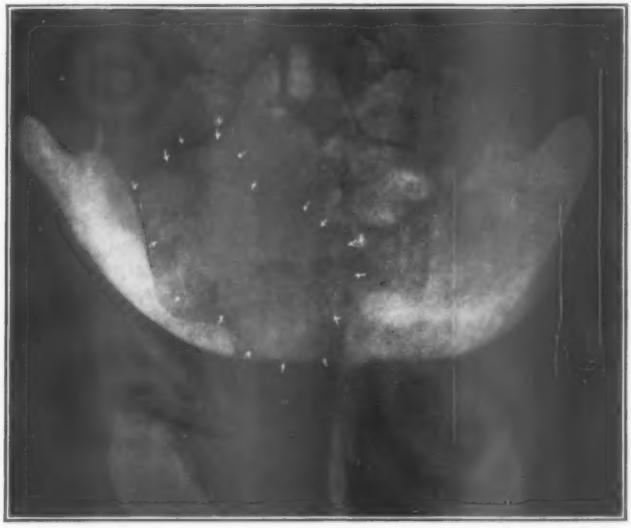

Figure I.

he drove a motor truck, mainly in the country. He had lived in Jerilderie, New South Wales.

His parents were alive and in good health. Two sisters were both living and well.

At the age of eighteen years he was thrown from a horse; his right hip was injured and he was treated for bruising; he was confined to his bed for three days. He contracted pneumonic influenza in 1925.

In 1916 the patient was treated for an attack of sciatica; he then complained of pain radiating down the back of the right leg to the ankle. The limb was stiff, but he could get about. The trouble cleared up completely in a few days.

In November, 1918, the patient suffered from severe pain localized in the lower portion of his right buttock; he described it as neuralgic in type and of a very persistent and sharp character. There was no tenderness on pressure. The pain was increased by walking or movement of the lower limb, and was sufficiently severe to prevent him from attending to his work; after a week or two he consulted a doctor in Jerilderie. Palliative treatment was given, but no improvement was observed. About six weeks from its onset the pain began to become less. In March, 1929, the pain was still present and the patient was referred to a

FIGURE II.

surgeon in Melbourne. An X ray examination was then made for the first time. The report was as follows:

> There is an area of absorption of the right half of the lower two pieces of the sacrum. The bone is not enlarged laterally, but the anterior and posterior walls are absorbed (as shown by stereoscopic films). No sclerosis or calcification is seen in the tumour mass (see Figure I).

In August, 1929, a small lump was observed over the right edge of the sacrum; this was situated approximately three centimetres from the middle line; it was firm and slightly raised; it was not tender on palpation; in size it was about 2·5 centimetres in diameter. Constipation first became apparent about this time. Some pain was still complained of and the subject was kept under occasional observation by his doctor in the country.

The patient paid another visit to his Melbourne surgeon in October, 1929, and was again examined by X rays. The radiologist reported that the area of absorption had increased in size. Though pain was still complained of, it was not a pronounced feature and was limited to the right buttock. The general condition was good. The patient was now told that he had a sarcoma of the sacrum. He was able to walk, but locomotion was difficult and attended with pain. He was able to return to his work intermittently and kept on until June, 1930, when weakness in the right leg and pain of increased severity in the buttock compelled him to cease. He still complained of constipation.

In June, 1930, the patient was admitted to the Melbourne Hospital. The pain was then severe enough to prevent sleep. The pelvis was examined by X rays and the skiagram is shown in Figure II. The X ray report from the Melbourne Hospital on June 25, 1930, was:

> Large area of bone destruction in the lower half of the sacrum, mainly on the right side, but extending across the mid-line. There is expansion of bone laterally with some destruction of the cortex (see Figure II).

Deep X ray therapy was administered on three occasions at intervals of ten days. The right lower limb was found to be slightly wasted.

FIGURE III.

This patient was admitted to the Austin Hospital in July, 1930, with the diagnosis of sarcoma of the sacrum. On examination a large tumour was found in the region of the sacrum as shown in Figure III. There was marked wasting of the right leg; walking was impossible. He was a strongly built young man of good muscular development, save for the wasting of the right leg. Examination of the lungs and heart disclosed no abnormality. The liver and spleen were not enlarged; the kidneys were not palpable. There was a deep mass felt in the right iliac fossa spreading across the mid-line behind the pubes. Tenderness was present over the mass on deep pressure. In the region of the right half of the sacrum and spreading outwards to the ileum, there was a large mass, fifteen centimetres in diameter; it was irregular, somewhat lobulated in shape and elastic in consistency. This mass was fixed to deep structures, though not to the skin or subcutaneous tissues; on deep pressure over the site tenderness was elicited. Rectal examination revealed a large globular mass projecting into the posterior wall of the rectum, deforming the lumen. The mucous membrane of the rectum was intact and not adherent to the mass. The prostate and vesicles were normal. No abnormality was detected in the cranial nerves. There was complete absence

of sensation over the tumour and also over an area corresponding to the last three sacral nerves of the right side.

The tendon reflexes were hyperactive; the responses to the plantar reflex on the left side was flexor, but on the right side the anæsthesia prevented stimulation.

Definite wasting of the muscles of the calf of the right side was present. There were no enlarged glands, inguinal, cervical or axillary. The Wassermann test gave no reaction. There was marked hypertrophy of both tonsils.

The patient at this time complained of severe pain in the region of the tumour and of pain radiating down the right lower limb. Constipation had slowly and progressively increased.

The patient had some frequency of micturition in January, 1931, for a few days, followed by complete voluntary loss of control.

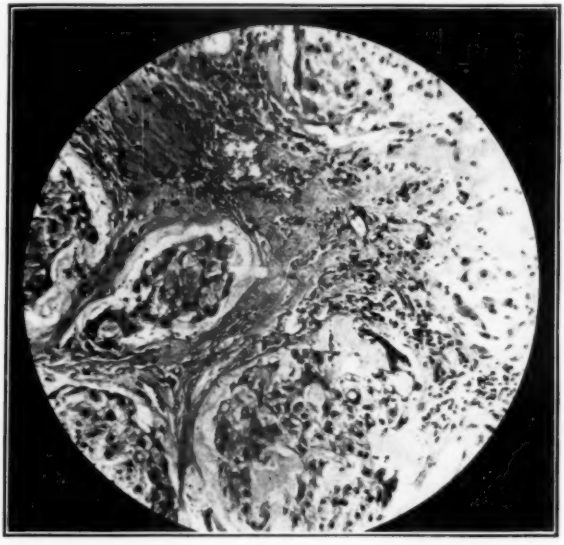

FIGURE IV.

By April, 1931, the tumour had increased in size and then measured twenty centimetres in diameter, projecting about eight centimetres posteriorly and spreading more extensively over the left buttock. A biopsy specimen was obtained and 150 needles of radon of 1·5 millicuries were inserted into the tumour under general anæsthesia. Towards the end of April the patient had many attacks of severe constipation, with colic and some degree of shock. His urine became heavily infected and was loaded with pus. For the first time the patient became febrile.

Under general anæsthesia in May, 1931, large masses of tumour tissue were removed from the posterior surface of the sacrum. The skin at the place from which the biopsy specimen was taken, remained unhealed, but there was no infiltration. During the operation, areas of calcification were observed and eroded fragments of sacrum were removed, together with masses of soft mucinous neoplastic tissue.

At this time physical examination of chest and heart disclosed no abnormality. The recent surgical scar was healing well at the ends, but was discharging blood stained material between sutures about the middle.

A blood film showed slight polychromasia. No nucleated red cells were seen. Many immature band forms of lymphocytes were present. The blood count was as follows:

| | |
|---|---|
| Erythrocytes per cubic millimetres .. .. .. | 3,400,000 |
| Hæmoglobin value .. .. .. .. .. .. | 80% |
| Leucocytes per cubic millimetre .. .. .. .. | 5,900 |
| Neutrophile cells .. .. .. .. .. .. | 74% |
| Eosinophile cells .. .. .. .. .. .. .. | 1·3% |
| Basophile cells .. .. .. .. .. .. .. | 1·0% |
| Lymphocytes .. .. .. .. .. .. .. | 16% |
| Mononuclear cells .. .. .. .. .. .. | 8% |

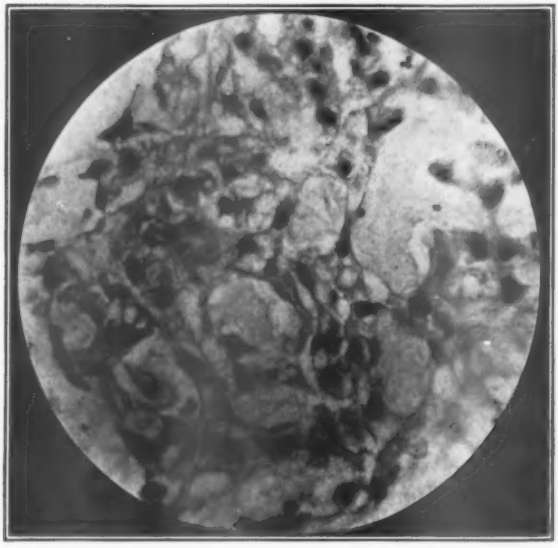

FIGURE V.

### Pathological Report.

Dr. Rupert Willis made a pathological examination and has kindly supplied the following report:

*Macroscopical Appearances.*—The tissue consists of loculi of gelatinous tissue in a fibrous framework. The loculi are of all dimensions up to two centimetres in diameter, irregular in shape, and often forming irregularly communicating spaces. The contained tissue is semi-translucent or opalescent in appearance, almost colourless, and for the most part devoid of hæmorrhage, calcification or degenerative changes.

*Microscopical Appearances.*—The gelatinous tissue consists of irregular clumps of large vacuolated cells and intervening masses of mucoid extracellular material. The cells vary in size up to forty microns or more in diameter, possess single or only occasionally multiple nuclei and appear in many areas to form syncytial masses. The protoplasm often exhibits many

large vacuoles, giving the typical physaliphorous cells of Virchow. The smallest cell clumps present a peripheral hyaline sheath distinct from the surrounding stroma.

Unna's polychrome methylene blue stains the homogeneous extracellular material pink, thus indicating its mucoid character; but the cell vacuoles remain unstained and indeed appear empty in all preparations.

*Diagnosis.*—All of the foregoing features are quite typical of chordoma, of which this specimen provides an excellent example. The only other tumours likely to be mistaken for a chordoma in this region are mucoid cancer of the rectum and myxochondroma of the sacrum.

The present tumour is clearly quite unlike a mucoid adeno-carcinoma; and, as it presents no areas resembling cartilage and as the characteristic physalpiphorous cells are present in abundance, confusion with myxochondroma is not possible.

The accompanying photomicrographs illustrate the features described. Figures IV is a low power view (× 100) showing the general structure of the mucoid cell clumps in the fibrous tissue stroma. Figure V (× 400) shows syncytial masses of vacuolated cells and areas of extracellular mucoid material.

**Acknowledgement.**

I wish to thank Dr. Willis, Pathologist to the Alfred Hospital, for his help in the pathological report. My thanks are also due to Dr. Blewitt, of the Austin Hospital, for his help in this case.

# RECURRENT MIXED CELL SARCOMA OF THE SCIATIC NERVE.

By ALAN F. HOBBS,

*Honorary Assistant Pathologist, Adelaide Hospital.*

## Clinical Report.

L.F., A FEMALE, aged forty-one years, was admitted to the Adelaide Hospital on January 24, 1929, complaining of a "contracting muscle in the left leg," a symptom which had been noticed for ten years. She had been suffering from a "nervous breakdown" for one month.

Examination revealed a middle aged woman, intensely nervous. The pulse was rapid, its rate being 128 per minute, and regular. The muscles of the left leg were wasted. At the back of the thigh there was a large mass which was firm and seemed to be attached to the ham-string muscles, but not to the femur. It was tender on palpation. The knee jerk was less active on the left side. At operation on January 29 a tumour, oval in shape and 15·0 to 20·0 centimetres (six to eight inches) in length, was found attached at its upper and lower ends to the sciatic nerve by two stalks which ran upwards and downward for some distance. These were divided and the tumour was easily shelled out. It was bluish in colour with numerous veins on its surface. On section it appeared macroscopically to consist of fibrous tissue with cystic spaces containing degenerated material. A smaller tumour, 1·25 centimetres (half an inch) in diameter, was dissected out from the sheath of the sciatic nerve. It did not invade the nerve. Recovery from the operation was uneventful. The wasting of the muscles of the left leg persisted. A post-operative course of deep X ray therapy was administered. The tumour (see Figures I and II) was reported on as follows by Dr. L. B. Bull:

> It is a large spindle-shaped tumour with a portion of fibrosed nerve trunk at one pole. The tumour is possibly a neurofibroma which has taken on malignant characters. There are large degenerated areas present, and some cystic spaces filled with gelatinous material. Sections of the solid portion show the histological picture of a spindle cell sarcoma.

The patient was readmitted on June 1, 1930, in a semiconscious condition, with a complaint of pain in the back of the neck and front of the head which had been present for three or four days. Until then she had been apparently quite well. She had vomited two or three times and her eyesight had been impaired during the last three days.

FIGURE I. Photograph of the primary tumour of the sciatic nerve (superficial aspect). The tumour has been incised longitudinally and the two halves turned back. The ends of the divided nerve trunk are seen, the intervening portion of the nerve being thinned out on the surface.

On examination the patient was lying on her back, with one hand on the back of her neck, apparently asleep. She was pale. When roused, she answered questions in a slow and vague manner. The right pupil was larger than the left and reacted more sluggishly. The movements of the face were weak, but equal on the two sides. There was some rigidity of the left arm and leg. The abdominal reflexes were absent on the left side. The knee jerk was more active on the left side. The urine contained a very small amount of albumin. On the next day there was paralysis of the external rectus muscle on each side. The fundi were normal in appearance. The tongue was protruded slightly to the right side. Lumbar puncture was performed, examination of the cerebro-spinal fluid revealing no abnormality of importance. The Wassermann test gave no reaction with either the blood or the cerebro-spinal fluid. Radiographic examination of the skull revealed no abnormality. On June 4 a convergent squint had developed in the left eye. The urine contained a trace of sugar. On June 6 the optic disks were swollen about three diopters. On June 9 the patient had become less drowsy, but a definite right facial paralysis had appeared. On June 13 she had again become more drowsy, and was transferred to a surgical ward for decompression, but later in the day she became unconscious and died.

FIGURE II. The cut surface of the tumour shown in Figure I.

### Autopsy.

The body was found to be moderately well nourished, with definite wasting of the left arm and leg. There was a depressed linear scar seven inches long on the outer side of the left thigh. There was some fibrosis beneath this scar. On the left sciatic nerve there were two ovoid swellings involving the nerve at about the middle of the thigh. One was situated on the superficial aspect of the nerve, but inside its sheath; the other separated the nerve bundles and presented

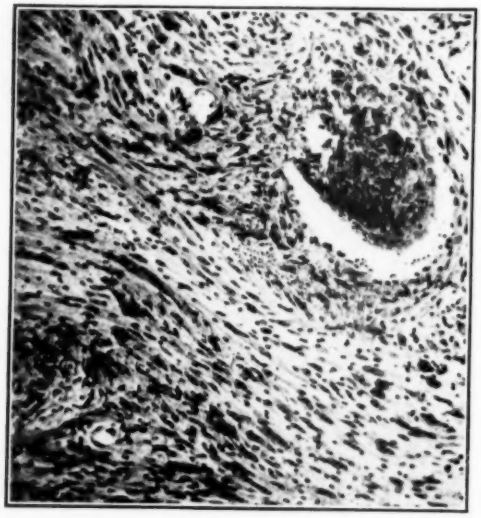

FIGURE III. Photomicrograph of one of the recurrent tumours of the sciatic nerve. ×115.

stance. Near the base of the right lung there was a small, firm, whitish tumour of the size and shape of a mulberry. There was scarring from an old tuberculous process at the apex of each lung and calcification of some of the bronchial glands. In the spleen there was a calcified hydatid cyst 6·25 centimetres (two and a half inches) in diameter projecting from the diaphragmatic surface.

On microscopical examination the sciatic nerve tumours (see Figure III) showed a whorled arrangement of spindle-shaped cells, separated from each other by varying amounts of intercellular matrix, with vascular channels showing thrombosis, probably some of the original vessels of the part. The nuclei of occasional cells a lobulated appearance on section (see Figures I and II). Each tumour was about 3·75 centimetres (one and a half inches) long and 1·25 centimetres (half an inch) thick. There was a smaller nodule on the superficial aspect of a branch of the sciatic nerve to the hamstring muscles. The tumours appeared to be encapsulated and did not infiltrate the adjacent nerve. On section, the tumours were pale and firm. The brain showed general flattening of the convolutions and there was very little cerebro-spinal fluid. There was a tumour 7·5 centimetres (three inches) in diameter, with an irregularly lobulated outline, situated beneath the cortex in the posterior part of the right parietal lobe, near the mid-line. It consisted of firm whitish tissue, containing a large cystic area of degeneration. It was moderately easily separable from the surrounding cerebral sub-

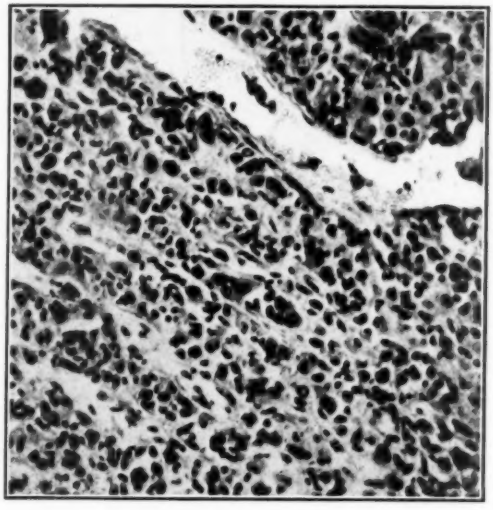

FIGURE IV. Photomicrograph of the metastatic tumour in the lung. ×207.

were large and irregular. The appearances were those of a spindle cell sarcoma with a good deal of stroma formation.

Sections of the nodule in the lung showed a central area consisting of closely packed rounded cells undergoing necrosis. Surrounding this area was a ring of fibrous tissue beyond which was a very cellular new growth (see Figures IV and V). In parts the cells were close together, highly irregular in shape and size, embedded in a matrix. In some cases the cells had several nuclei and some showed irregular mitoses. Between the cells were spaces lined by flattened endothelium which seemed almost to merge with the tumour cells, suggesting an endothelioma. There seemed a tendency for hyaline fibrous tissue to form, separating the cells and finally extinguishing them. The growth in the lung was much more cellular than that in the sciatic nerve and the cells were much more irregular. In the latter only occasional cells were large in size or showed irregularity of the nuclei.

The brain tumour (see Figure VI) was seen to be circumscribed and to present appearances similar to those of the deposit in the lung, the stroma in the former being somewhat coarser. Sections of all the tumours were stained by Van Gieson's method, the stroma in each case assuming a brownish-yellow colour in contrast to the red colour assumed by the connective tissue of the unaffected structures in relation with the growth.

FIGURE V. The tumour shown in Figure IV under a higher magnification (×414).

### Comment.

Multiple neurofibromata of the deeper nerve trunks occur relatively commonly, usually in association with cutaneous neurofibromata in cases of von Recklinghausen's disease. According to Ewing,[1] the subcutaneous and deeper tumours are generally more cellular than the cutaneous and have a much more serious prognosis in that, while the latter rarely become malignant, the former are very prone to undergo sarcomatous change. The tumours are often multiple and there is a tendency for fresh tumours to appear on more proximal portions of the affected nerve trunk. After removal there may be local recurrence with infiltration of the nerve and adjacent structures, or there may be a development of fresh circumscribed nodules in neighbouring portions of the same nerve.

Apart from their occurrence as a part of a generalized neurofibromatosis, sarcomata of the large trunks are rare, the sciatic nerve being most commonly affected. Alexis Thomson[2] has found that sarcoma affecting the large nerves of the limbs has a very high degree of malignancy, tending to recur locally and to give rise to metastases, even after removal of a considerable portion of the affected nerve trunk with the tumour.

In the present case the main tumour was of large size, but was easily enucleated. Neither in connexion with this nor with those developing in the nerve

subsequent to operation was there any evidence of infiltration of the nerve or of the surrounding tissues.

The metastatic tumour in the brain was almost certainly present before the removal of the primary growth. It is interesting to observe that in von Recklinghausen's disease it is not uncommon to find associated tumours in the brain and spinal cord, usually gliomata, and also meningeal tumours.

Although in this instance dissemination had probably occurred before operation was undertaken, the advisability of amputating the limb should always be seriously considered. However, before this is done a careful search should be made for the presence of secondary deposits.

Microscopically the tumours recurring locally in the sciatic nerve were similar in appearance to the primary growth, without the evidences of increased malignancy which might have been expected. The metastases, on the other hand, were very different, showing striking variations in the size and shape of the cells, irregularity in shape, and large size of the nuclei, many multinucleated cells and numerous mitoses.

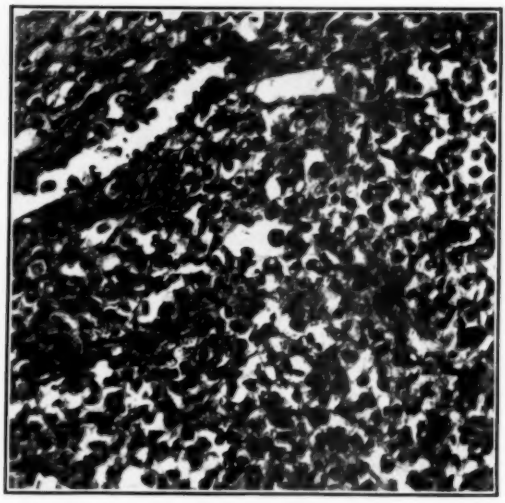

FIGURE VI. Photomicrograph of the metastatic tumour in the brain. × 207.

Kaufmann[5] discusses Verocay's views on the nature of the neurofibromata. Verocay claims that the tumours usually known by this name arise from one of two types of tissue or, in some cases, from a mixture of these. From the results of his work he holds that the tumour which he terms a neurinoma arises from the cells of the sheath of Schwann, or corresponding embryonal cells arising from neurocytes. Supporting this view is the fact that with Van Gieson's method of staining the stroma of this growth stains yellow, in contrast with the red colour assumed by ordinary connective tissue, showing that this stroma does not consist of true connective tissue. The other type of neurofibroma arises from the connective tissue forming the supporting framework of the nerve and stains red with Van Gieson's stain. In this case and in the case in which a mixture of these two types of tissue is present, the tumours are termed by Verocay neurinofibromata. This author further believes that by an increase in the number and polymorhism of the nuclei there may arise a "*neurinoma sarcomatoides.*"

This neurinomatous tissue also occurs, as emphasized by Cushing,[4] in tumours of the acoustic nerve. Although, however, these at times histologically resemble sarcomata, they have no tendency to metastasize.

Sections of all the tumours in the case being reported gave this peculiar reaction with Van Gieson's stain. This and the fact that the tumours of the sciatic nerve were multiple suggest that they were pathologically and ætiologically identical with the sarcomata arising in neurofibromata in cases of von Recklinghausen's disease, even though, in this instance, there were no apparent cutaneous lesions.

**Summary.**

1. A case of sarcoma of the sciatic nerve with metastases in brain and lung is reported.

2. Its identity with similar tumours occurring in cases of von Recklinghausen's disease is suggested.

3. Emphasis is laid on the serious prognosis of cases of neurofibroma of the deeper nerve trunks.

**Acknowledgements.**

For permission to publish the clinical report I am indebted to Dr. A. Britten-Jones and Dr. C. T. C. de Crespigny, under whose care the patient was, to Professor Cleland and Dr. L. B. Bull for assistance with the pathological report, and to Mr. McLennan for the photographs.

**References.**

(1) James Ewing: "Neoplastic Diseases," 1928, pages 167-168.

(2) Alexis Thomson: "On Neuroma and Neurofibromatosis," 1900; quoted by G. C. Choyce in "A System of Surgery," 1925, Volume I, page 542.

(3) E. Kaufmann: "Pathology for Students and Practitioners," 1929, Volume III, pages 2029-2030.

(4) H. Cushing: "Tumours of the Nervus Acusticus," 1917, page 199.

# Surgery in Other Countries.

*[In this column will be published short résumés of articles likely to be of practical value from Journals published in other countries and not readily accessible to surgeons in Australia and New Zealand.]*

## The Treatment of Perforated Gastric and Duodenal Ulcer by Neumann's Omental Cuff.

W. Braun, writing in *Der Chirurg*, May, 1931, discusses the treatment of perforated gastric and duodenal ulcer by Neumann's omental cuff. In 1907 Neumann originated an operation for the treatment of perforated gastric and duodenal ulcer. The principles of this operation are that a rubber tube was introduced into the perforation so as to make it, as it were, into a gastrostomy; the omentum was fashioned into a tube or cuff so as to surround the rubber tube and thus serve as a protective omental tube extending between the opening in the stomach and the abdominal wall. This unusual and rather original "omental

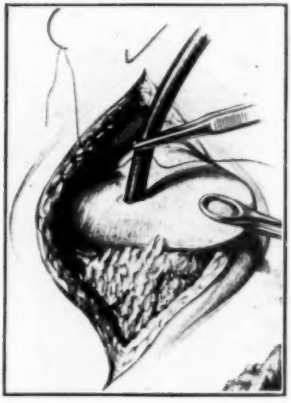

Figure I.

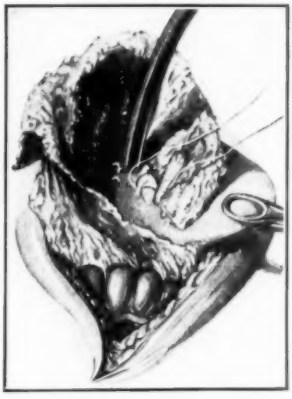

Figure II.

cuff method" of treating perforated gastric and duodenal ulcer has been for some time a vogue with some German surgeons, and its practical value has been established by many writers—Friedmann, Küchel, Neller, Mühsam and others.

This operation has been the routine treatment of perforated gastric and duodenal ulcer in the surgical department of the Metropolitan Hospital, Friedrichshaus, Berlin. The series reported by Professor Braun comprises two hundred and sixteen cases; eighty-four of these cases were previously reported by Salzman; the remaining one hundred and thirty-two patients were operated on by Professor Braun. Only on one occasion, when the ulcer was on the posterior wall of the stomach, was it impossible to use the "omental cuff" method. In far the

greater number of cases the ulcers treated by this method were in the neighbourhood of the pylorus.

*Technique.*—The perforation having been found, the surgeon inserts into it a rubber tube which is the exact size of the opening. This tube is passed into the stomach towards the duodenum for 5·0 centimetres (two inches) and it is then fixed by sutures to the margin of the perforation. The omentum is now sutured around the tube, to the visceral peritoneum around the margin of the perforation and to the parietal peritoneum. In this way is formed an omental cylinder, which surrounds the rubber tube and connects the perforation with the opening of the abdominal wall (see Figures I, II, III and IV). The rubber tube, protected by the "omental cuff," establishes continuous drainage of the stomach and of the duodenum. It can be utilized to prevent stasis of gastric contents during the first few days following the operation. A further advantage is that nourishment may be administered by the mouth, soon after the operation,

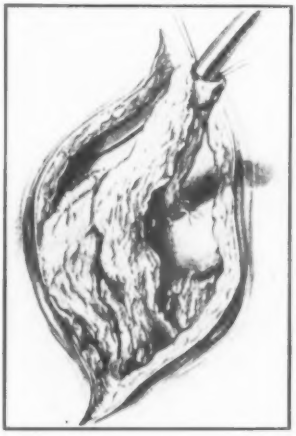

FIGURE III.

FIGURE IV.

without any fear of a gastric retention. The tube is removed about the tenth or twelfth day, and the fistulous opening is covered with an oil tampon. As a rule, the fistula closes in a few days.

*Immediate Results.*—The immediate results are represented in Table I.

TABLE I.

| Group. | Number. | Cured. | Died. | Percentage. |
|---|---|---|---|---|
| Operated on nine hours after perforation (early cases) .. | 100 | 88 | 12 | 12·0% |
| Operated on later than nine hours .. .. .. .. .. | 116 | 55 | 61 | 52·6% |
| Total number .. .. | 216 | 143 | 73 | 33·6% |

As in all similar statistics, this table shows a marked difference in the results of the operation in the late cases. Of the twelve fatal cases which occurred over a period of twenty years after the early operation, five occurred in the year 1930. In only one hundred of the two hundred and sixteen cases, or 46·5%, was the operation performed within a nine-hour limit. The author points out that material improvement in operative results is to be expected only in these early cases. *Post mortem* examination showed that there was no leakage or suture insufficiency in the region of the omental cuff. The author even gained the impression that the presence of the omentum in the upper part of the abdomen afforded a protection against local peritonitis.

It is difficult to come to any conclusion as to the value of this operation, for, as the author points out, there are so many varying factors: the skill of the operator, the relation of the rupture to the time of operation, the resistance of the patient *et cetera*. Since more than half of Braun's patients were operated on after the nine-hour limit, a comparison of his results with those of other authors should afford a good indication of the efficiency of Neumann's method. This comparison is set out in Table II.

TABLE II.

| Author. | Patients. | Deaths (Percentage). |
|---|---|---|
| Bager (total statistics) .. .. .. .. .. | 1,495 | 32·8 |
| Bager (Maria Hospital, Stockholm) .. .. | 97 | 18·6 |
| Brutt .. .. .. .. .. .. .. .. .. | 140 | 40·0 |
| Dunbar .. .. .. .. .. .. .. .. .. | 387 | 46·0 |
| Neumann .... .. .. .. .. .. .. .. | 126 | 61·0 |
| Paugger .. .. .. .. .. .. .. .. | 85 | 18·8 |
| Radoievitez .. .. .. .. .. .. .. .. | 685 | 30·2 |
| Tekelenburg .. .. .. .. .. .. .. .. | 100 | 23·0 |
| Braun .. .. .. .. .. .. .. .. .. | 216 | 33·6 |

Braun claims that the remote results of the Neumann's "omental cuff" method are satisfactory. A "follow-up" examination of fifty-eight patients showed that forty-seven were quite free from any symptoms. X ray examinations, in a proportion of these cases, showed that there was no local residue and that the emptying time in the majority was normal. The adhesions, which were artificially produced by the omental cuff, caused typical alterations in the form of the stomach; but they in no way disturbed the emptying mechanism. He claims that this method has essential advantages over the usual conservative operations employed in perforated gastric and duodenal ulcer. For example, in the over-sewing method, with or without omental covering, it is not always possible to suture satisfactory a callous ulcer; furthermore, the over-sewing may lead to a stenosis or leakage through the sutures may take place; finally, there is the disadvantage of not having continuous gastric drainage immediately after the operation. The simple "omental cuff" method can nearly always be carried out, and presents none of these disadvantages. The combination of over-sewing of the ulcer with gastro-enterostomy, for the purpose of avoiding gastric stasis and any immediate post-operative stenosis, is a formidable operation for a weakened patient. Moreover, there is the danger of the future occurrence of a peptic ulcer. Finally, in patients who have undergone gastro-enterostomy greater difficulties are experienced if a gastric resection becomes necessary in the future.

The value of this simple and safe method of operating assumes greater importance when it is compared with Bager's operative results in the Maria Hospital in Stockholm. Bager employs an operation somewhat similar in principle to that of Neumann. In this operation he excises the ulcer, sutures it transversely, and then performs a gastrostomy on a sound part of the stomach. Here the gastrostomy, which gives continuous drainage, is a most important principle of

the treatment. Among ninety-three patients operated on, he had fifteen deaths. Professor Braun claims that Neumann's method is simpler and safer than Bager's method, and also that it has not the disadvantages attendant on suturing a callous ulcer.

While we may not consider that the operation for gastric or duodenal perforation, here advocated by Professor Braun, is the operation of choice in all cases, nevertheless, it is based on a very important principle, and it should have its place in surgery. It will certainly be found a life-saving procedure in late cases, and here it may be found to be the operation of choice.

H. B. DEVINE.

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THE AFTER-TREATMENT OF RESECTION OF STOMACH FOR GASTRIC ULCER.

IN *Deutsche Zeitschrift für Chirurgie*, Volume CCXXXI, Numbers 5 and 6, 1931, F. W. Lapp and H. Neuffer, from C. von Noorden's Division of Metabolic Disturbances of the Vienna Hospital, discuss the after-treatment of patients on whom gastric resection has been carried out for ulceration.

Resection necessarily entails an alteration in the process of digestion owing to the altered motility and secretion of the gastric remnant. The remnant of the stomach no longer retains its function of storing the masticated food and X ray investigations have shown that it does not possess any power of peristalsis.

During meals there is a direct and continuous flow of the swallowed food through the artificial stoma into the jejunum. The flow is governed purely by gravity. Any power of contraction and dilatation of the stoma is, at first at least, very slight. The X ray investigations of Goetze have shown that after a gastric resection the main course of the food is along the lesser curvature and every force in the resected stomach favours a precipitate emptying. This tends to eliminate all chemical action in the stomach. Apart from this, the operation entails the resection of the greater part of the acid-secreting portion of the stomach. The investigations of Löhr and Stera revealed an achlorhydridia in 96% of patients after gastric resection, whilst the duodenal secretion remained normal in 84%. Resection did not lead to any change in the digestion of carbohydrates.

Though secretion of acid may greatly reappear, the acid so formed has little opportunity of action owing to the rapid emptying of the stomach. The power of disinfection on the part of the stomach is also lost, and this must be borne in mind in the evolution of a suitable diet. Then there is the additional factor that the altered course of the gastric contents, direct into the jejunum, leads to a delay of the admixture of the bile and the pancreatic secretion, a delay which may, moreover, be increased by reflex slowing following the resection of the pylorus and by post-operative spasm in the duodenum.

The authors contend that the problems of the after-care of patients in whom resection of the stomach has been carried out, are, in the main, dietetic.

The authors admit that the need for dietetic treatment after gastric resection, in order to meet the altered conditions of digestion, has long been recognized by both surgeons and physicians, and they emphasize that nowadays no patient after resection for gastric ulcer should be left in any doubt that, whilst the ulcer has been removed, the operation for its removal has created a set of conditions which will require constant care and treatment.

It was originally the custom of the authors to follow the practice of other surgeons and physicians and to deal with post-operative complications with an appropriate diet. Their experience, however, created the desire to formulate a diet with the object of avoiding complications. The use of such a diet led to the non-appearance of the complications which had formerly been observed.

Amongst the early complications was diarrhœa. Whilst the authors regard dietetic errors as the chief cause for its occurrence, they recognize that the deprivation of the bactericidal action of the normal gastric juice may be a contributing factor, and they insist upon scrupulous cleanliness of the mouth and upon the exclusion of all raw food.

Other complications observed were various forms of intestinal dyspepsia, whether putrefactive, fermentative or the result of medicinal intervention. Any of these forms of dyspepsia is likely to be accompanied by diarrhœa, the result of an acute catarrhal enteritis, or an irritative colitis. In the majority of cases the occurrence of diarrhœa is contributed to by the precipitate emptying of the stomach remnant.

The chief essential is the establishment of an efficient digestion of a diet with an appropriate caloric value. The authors warn against the common error of inaugurating a "fattening" diet (*Mast Kur*) immediately after the operation. They insist that the danger of a disturbed nutrition is far greater than that of a deficient nutrition. They severely condemn and issue a caution against the forced use of beef-tea and "egg flip" (egg and alcohol). Owing to the altered conditions such articles of diet are unsuitable, the intestine is incapable of dealing with them, and they consequently act as local irritants or cause increased peristalsis and rapid emptying. The result is the occurrence of diarrhœa and this, as a rule, leads to a new complication brought about by the use of opiates *et cetera*, which produce an intestinal stasis and irritative colitis. The end result of what was intended to be a nourishing diet is a defective nutrition.

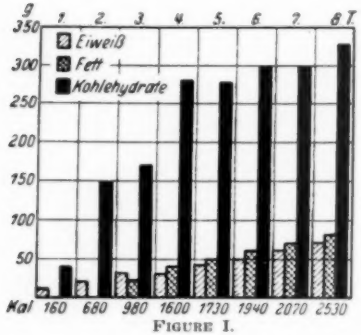

FIGURE I.

Every severe operation means a considerable shock to the processes of metabolism, and one of the first considerations must be to counter the resulting collapse by the use of such foods as will act quickly and continuously as metabolic stimulants. With this in view, the authors refer to von Noorden's insistence on the importance of a rich supply of carbohydrates. Carbohydrates are easily and rapidly assimilated; they are much superior to proteins and fats.

For the first thirty-six hours it is desirable that the small gastric remnant should be left at rest. During this period the patient is given continuous rectal infusion of a 5% grape-sugar solution by the drop method and no nourishment is given by the mouth. This is followed by the administration of nourishment, fluid at first, but increasing in consistency in a graduated manner. Then, provided that the patient is able to masticate properly, food of a more solid nature is given. In passing from the fluid to the more solid forms of food, consideration is given to the degree of security of the gastro-intestinal suture. It is an important axiom of von Noorden that all food must be so cooked and prepared that with the aid of mastication it enters the intestine in a form which is loose and presents a large surface.

The initial absence of free hydrochloric acid after gastrectomy necessitates a diet which may be ready for assimilation in the intestine without the preliminary preparation by the gastric juice. Stimulants of acid must be avoided as well as all raw food material. Food containing egg albumen must be restricted because of the absence of gastric secretion. The occurrence of rapid or even precipitate emptying necessitates the giving of small meals in the form of thick porridge and soups. The soups, however, should not contain an acid stimulant in the form of beef-tea. The delayed and impeded admixture of the duodenal secretion calls for restriction of fatty contents. With the reestablishment of the formation of acids, addition of fats is indicated the more so as these tend to depress acid secretion.

The authors give a curve showing the amount of proteins, fat and carbohydrates with the caloric value of the diet for the first eight days. It graphically demonstrates the preponderance of carbohydrate ingredients of the diet (see Figure I).

As an example of a soup which complies with the principles enunciated, the authors give the following recipe: Take 35 grammes of oatmeal, or barley or rice, mix with one-half litre of water and heat to boiling point, then place over boiling water for two to three hours; then stir soup through a fine sieve and dilute with hot water and again force through a conical sieve and boil with the addition of a little salt.

B. T. ZWAR.

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HALLUX VALGUS.

KURT EICK, of the Surgical Orthopædic Department of the Pius Hospital at Oldenburg, describes (*Zentralblatt für Chirurgie*, 1931, Number 6, page 326) a new operation for *hallux valgus*. This author is of opinion that the high percentage of bad results obtained by the present operative methods is due to the lack of a proper consideration of the basic orthopædic conditions. These are: general *pes valgus*, with outward rotation of the foot and flattening of the anterior transverse arch; slackening of the joint capsules and ligaments; stretching of the *abductor hallucis* and the substitution for it of the *adductor hallucis* for weight bearing. He criticizes the results of various present procedures and lays down, as essential requirements for a successful operative method, the following conditions: (i) Due appreciation of the underlying pathogenic stress; (ii) avoidance of damage to the joint; (iii) restoration of the anterior transverse arch; (iv) strict post-operative after-treatment and splinting with plaster; (v) real interest and patience on the part of patient and of surgeon.

Fig. 1

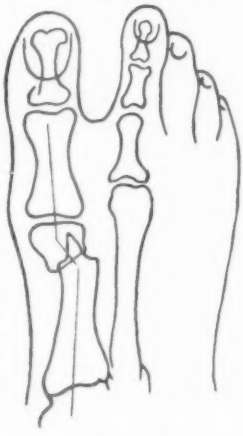

Fig. 2

The steps of the operation are as follows:

1. An incision is made on the medial side of the first metatarsal, from the exostosis, extending proximally for about six to seven centimetres, cutting through all tissue to the bare bone, but avoiding the joint and the bursa.

2. The periosteum is freed from the first metatarsal bone for the whole length of the wound.

3. A transverse osteotomy is made with a chisel immediately behind the head of the metatarsal, 1·5 to 2·0 centimetres from the joint, a sandbag being placed so as to give counterpressure and thus avoid splintering.

4. With Luer's forceps, a piece of bone 1·0 to 1·5 centimetres long is resected from the proximal fragment in such a manner that at the dorsal aspect of the metatarsal shaft a sharp protruding spur of bone is left as far as the original length (see Figure I). This spur is wedged into the medullary cavity of the head. It thus unites the two fragments with the required shortening, and also allows the distal fragment, with the great toe, to be displaced into the desired direction without endangering union.

5. The periosteum is sutured with catgut; the tendon of the *abductor hallucis* is freed, and, under firm tension, is sutured to the periosteum of the distal fragment in such manner that it maintains a continuous pull, and presses the head firmly down on the spur of the shaft (see Figure II).

6. The skin is sutured and the wound bandaged.

A stiff wadding pad is put between the first and the second toes to ease the tendon suture. A plaster bandage is applied up to the knee; the plaster is applied to the foot as for *pes planus*, the anterior arch being moulded in the plaster. Finally, a small splint is embedded in the plaster on the medial side, extending to the ball of the toe. A strip of strapping fixes the toe to this splint, and serves further to take the strain off the sutured abductor tendon. The plaster is changed in two or three weeks, the second plaster in another three weeks. On the removal of the plaster, a splint made on the model of the plaster is immediately applied, and broad shoes with the toe-caps as wide as possible are used. For a few weeks a small pad of rubber sponge should be worn between the first and second toes, but with the wearing of shoes the apparent spreading out of the great toe soon disappears, as the other toes come over medially and lie close to it. The final result, with the second toe the longest, follows the form of the classical foot described by C. H. Stratz.

This operation fulfils the requirements laid down, and the operator has used it for two years for all patients requiring operation for *hallux valgus*. His follow-up records show outstandingly good results.

ARTHUR BROWN.

# Reviews.

## "AVERTIN."

THOSE who have followed the history of the introduction of "Avertin" know that extraordinary precautions were taken by the manufacturers to insure the reliability of the product before it was placed on the open market. It may be claimed that the indications for the use of "Avertin" are known and that its limitations are recognized. Most surgeons who have used the product speak well of it, but they realize that it is a "basal" anæsthetic and nothing more. Dr. Kempson Maddox, of Sydney, has produced a useful guide to the administration of the drug in "An Introduction to 'Avertin' Rectal Anæsthesia."[1] This is a book of 110 pages in which the history of rectal narcosis, the chemistry and pharmacology and the clinical application of "Avertin" are clearly set out. The technique of its use is given in detail and the treatment of complications is well described. Dr. Maddox is enthusiastic in his advocacy of the drug, but at the same time he is insistent on its limitations. Professor Harold R. Dew, in a foreword, describes the book as "an object lesson of the manner in which the investigation of the action and use of any new agent should be attacked." The book may be recommended as a reliable guide to those as yet inexperienced in the use of "Avertin."

## INTRACRANIAL INFECTION.

ALL those interested in surgery of the nasal sinuses and of the brain will welcome "Intracranial Pyogenic Diseases," a book by A. Logan Turner and F. Esmond Reynolds.[2] This book is described as "A Pathological and Clinical Study of the Pathways of Infection from the Face, the Nasal and Paranasal Air-Cavities." The authors have published a number of their observations from time to time in *The Journal of Laryngology and Otology*. They have continued their studies over many years, and base their findings on the study of 55 cases. Twenty

[1] "An Introduction to 'Avertin' Rectal Anæsthesia," by J. Kempson Maddox, M.D., Ch.M., M.R.C.P., with a foreword by H. R. Dew, M.B., F.R.C.S., F.R.A.C.S.; 1931. Australia: Angus and Robertson. Demy vo., pp. 132. Price: 9s. net.

[2] "Intracranial Pyogenic Diseases: A Pathological and Clinical Study of the Pathways of Infection from the Face, the Nasal and Paranasal Air-Cavities," by A. L. Turner, M.D., LL.D., Hon. F.R.C.P., F.R.S.E., and F. E. Reynolds, M.D., D.T.M. & H., M.R.C.P.; 1931. Edinburgh: Oliver and Boyd. Royal 8vo., pp. 291, with 82 illustrations, 21 being coloured. Price: 12s. 6d net.

of these have been subjected to searching histological examination and 35 were cases encountered in the Ear and Throat Department of the Royal Infirmary of Edinburgh.

The primary focus in the 55 cases was situated in the following areas: the face, four cases; the paranasal sinuses (the authors use the term "air-cavity" in place of "sinus"), 45 cases; the fauces, one case; the middle ear cleft, five cases. In 21 instances the infection was carried to the intracranial structures either entirely by the venous blood stream or (as in eight instances) first by direct extension through the bone and finally by the blood stream. Cases 22 and 41 form a group in which the whole process of infection was that of direct extension of the inflammation through the bone and *dura mater*. In the third group, Cases 42 to 45, the infection passed along the perineural sheaths. In the fourth group, Cases 46 to 49, the route taken by the infection was not determined. The last group, Cases 50 to 55, represents a series in which general blood infection occurred without concomitant infection of the dural blood sinuses. The groups are discussed in turn in successive chapters and commentaries on the cases are given. The organisms most frequently found responsible were streptococci, pneumococci and staphylococci.

Limitations of space prevent a further description of the details of this important study. The work has been carried out in a most painstaking and consistent manner. No surgeon who deals with cranial infections can afford to leave this book unstudied. If he gains nothing more, it will certainly show him how fatal cases of intracranial infection should be investigated. A word of praise must be given to the publishers, who have done their work admirably. The illustrations, 82 in number, are well produced, and when we find 21 of them in colour we marvel at the cheapness of the book. It deserves to have a wide circulation.

# Proceedings of the Royal Australasian College of Surgeons

## ANNUAL MEETING.

THE annual meeting of the Royal Australasian College of Surgeons was held at Melbourne on February 17 to 20, 1932.

### INAUGURAL MEETING.

The inaugural meeting was held at the Wilson Hall of the University of Melbourne. There was a gathering of nearly two thousand guests. These comprised surgeons from all parts of Australia and New Zealand, representatives of the High Court of Australia and the Supreme Court of Victoria, and of all the professions. Most of the guests wore academic dress and the gathering presented a striking and colourful appearance. At a quarter past eight o'clock members of the Council of the College and of the University, led by His Excellency Lieutenant-Governor Sir William Irvine, proceeded up the aisle and took their places on the dais. The group on the dais included the President of the Royal Australasian College of Surgeons (Sir Henry Newland), Mr. C. H. Fagge, the Vice-President of the College (Sir Louis Barnett, New Zealand), the Chancellor of the University (Sir John MacFarland), the Vice-Chancellor (Sir James Barrett), the Minister for Public Works (Mr. J. P. Jones), representing the State Ministry; the President of the Professorial Board (Professor Agar), the Dean of the Faculty of Medicine (Professor Osborne), Mr. H. R. G. Poate (New South Wales), Mr. H. B. Devine (Victoria), Mr. E. D. Ahern (Queensland), Mr. Alan Newton (Honorary Secretary of the College), Mr. R. Hamilton Russell (Victoria), Mr.

F. P. Sandes (New South Wales), Mr. R. B. Wade (New South Wales), Mr. A. L. Kenny (Victoria), and the Registrar of the University (Mr. J. P. Bainbridge).

Sir William Irvine, in declaring the meeting open, extended a cordial welcome on behalf not only of the great gathering present, but of all the people of Victoria, to their distinguished visitor, Mr. C. H. Fagge. Mr. Fagge was not only a very eminent surgeon, he was the emissary of the Royal College of Surgeons of England, chosen to come to Melbourne to present a mace to the Royal Australasian College of Surgeons. This was a ceremony of great significance and moment to the whole profession. The mace was more than a mere token of goodwill and fellowship; it was more even than a beautiful and valuable gift by the most ancient and most renowned institution of surgery in the world. It might possibly be described as a symbolic sharing of a great heritage—a symbolic resumption of a great responsibility. The heritage was that of a high and honourable tradition associated with a name not only of the older College of Surgeons, but with the whole profession of surgery in Great Britain and also in Australia and New Zealand. The responsibility was that of maintaining those high traditions free from smirch or dishonour.

Sir Henry Newland introduced Mr. C. H. Fagge and said: "My first duty on this great occasion in the history of Australasian surgery is to introduce to you, if indeed an introduction be necessary, Mr. Charles Hilton Fagge, Senior Surgeon on the surgical staff of 'Guy's,' that famous London hospital. He is here today as the envoy of the Royal College of Surgeons of England, and is charged with a special mission. I venture to say, and I trust it is not an impertinence to say, that the Council of that august body could not have made a wiser choice. A witty Frenchman once said that there were two things no countryman of his could escape, death and the Legion of Honour. He might have added a third, for no man of any country can free himself from his heredity. Hilton, Mr. Fagge's uncle, taught the world of medicine the true significance of pain and how to soothe it. Our visitor's father, whose brilliant career at 'Guy's' ended at the early age of forty-six, won the gold medal in surgery of the University of London, and wrote a textbook of medicine which is a classic. The laurels on the brows of his forbears have served as a spur to Mr. Fagge's own endeavours, and he stands before us as a surgeon who has achieved distinction. 'So man's true fame must strike from his own deeds.' Ladies and gentlemen, I present to you Mr. Charles Hilton Fagge, sometime Vice-President of the Royal College of Surgeons of England, and I ask you to honour the surgeon with the honour due unto him."

Mr. Fagge acknowledged the introduction and presented to Sir Henry Newland a message from Lord Moynihan, President of the Royal College of Surgeons of England. (This message is printed elsewhere in this issue.)

### Presentation of the Mace.

Mr. Fagge then formally presented the mace and said: "In the name and by the authority of the Council of the Royal College of Surgeons, I ask you on behalf of the Fellows of the Royal Australasian College of Surgeons to accept this mace, which my colleagues hope may remain throughout the existence of our two colleges an emblem of the brotherly affection which binds us together."

Mr. Fagge described the mace and explained the significance of its design in a speech which is printed in another part of this journal.

Sir Henry Newland accepted the mace in terms printed elsewhere in this issue.

### Admission of Fellows.

The following Fellows were formally presented to the President by the Honorary Secretary and admitted to fellowship:

*New South Wales.*—George Moncrieff Barron, Bernard Brooks Blomfield, Cecil Richard Blomfield, William Elphinstone Kay, John Walwyn Shepheard Laidley, Brooke Moore, Walter Perry, Gerald Keith Smith, Walter Jaques Stack.

*Queensland.*—John Joseph Power, Neville Graham Sutton, Paul Ernest Voss.

*South Australia.*—Lionel Oxorrow Betts, Robert McMahon Glynn, Owen Meredith Moulden, Harold Keith Pavy, Brian Herbert Swift, Laurence Algernon Wilson.

*Tasmania.*—John Bruce Hamilton.

*Victoria.*—James Mayo Buchanan, David Dorey Browne, John Boyd Colquhoun, Francis Florence D'Arcy, George Ronald Davidson, William Raymond Dudley Griffiths, Charles Hugh Hembrow, Raymond Valentine Hennessy, Norman Anderson Longden, Thomas Glass Millar.

*Western Australia.*—Reginald Dalton McKellar Hall.

The Honorary Secretary, by direction of the Council, presented to the President George Robin Adlington Syme for admission as a Fellow. He explained that George Robin Adlington Syme had that day been elected a Fellow, and should not normally be presented until the next annual general meeting. The Council deemed it fitting that he should be formally admitted on the occasion of the delivery of the first oration in memory of his father, the late George Adlington Syme, the first President of the College.

The Honorary Secretary then presented Charles Herbert Fagge, who was admitted as an Honorary Fellow of the College.

### The George Adlington Syme Oration.

Mr. C. H. Fagge delivered the first George Adlington Syme Oration. This oration will be published in a subsequent issue.

At the conclusion of the ceremony, preceded by a mace-bearer carrying the mace, members of the Council of the College and the University, led by His Excellency the Lieutenant-Governor of Victoria, left the hall as a procession down the aisle.

## BUSINESS MEETING.

At the annual business meeting a full report of the Council, together with a balance sheet, was presented and circulated to the Fellows.

The more important decisions made by the Council are summarized as follows.

### Policy of the College in Regard to the Future Admission of Fellows.

The Council has given anxious consideration to the whole question of the policy of the College in regard to the admission of Fellows. Under the present system, a candidate must be nominated by three Fellows and must give the names of five other medical practitioners, three of whom must be surgeons, as references. The five referees are then asked to fill in a confidential report concerning the surgical judgement and ability of the candidate and his moral and ethical standing. The candidate must also, in his application form, furnish details of his undergraduate and post-graduate education. The application, together with the reports of the referees, is then considered by the State/Dominion censors who report to the Council of the College, which then decides whether to admit, reject or defer the application.

The Council recognized that, under this system, it is difficult to estimate the professional capacity of the candidate and that, in consequence, it is impossible to maintain an equal standard of admission in the various Australian States and the Dominion of New Zealand. It has, therefore, decided to institute an Australian and a New Zealand Board of Censors, and has instructed the Executive Committee to draw up regulations and to give notice of the necessary alterations in the Articles of Association of the College, so that admission to fellowship can be obtained only after an interview between the candidate and one or other of these boards, which will be empowered to make any inquiries or apply any tests which may seem desirable both as to the candidate's knowledge and his general suitability for admittance as a Fellow.

Notice of the necessary alterations in the Articles of Association will be issued to all Fellows prior to the next annual general meeting. If the recommendations of the Council are adopted at this meeting, the future requirements for fellowship will be as follows:

1. A minimum period of five years' surgical training after graduation.
2. A senior surgical qualification recognized by the Council.
3. An investigation of the merits of the candidate, particularly of the extent whereby he has benefited from his training, by an Australian or a New Zealand Board of Censors before which the candidate must appear in person.

In order to define the term "senior surgical qualification" and the possibility of exemption therefrom in the case of candidates of exceptional surgical ability or experience, the Council has passed the following regulation:

1. A candidate for fellowship of the Royal Australasian College of Surgeons shall possess a senior surgical qualification in general or special surgery approved by the Council.
2. This senior surgical qualification shall entail a primary examination in anatomy and physiology and a final examination in surgery, surgical anatomy and surgical pathology. These two examinations need not necessarily be passed in the same university or college of surgeons.
3. The Council, at its discretion, may dispense with these requirements in the case of candidates of exceptional surgical ability or experience who have been legally qualified medical practitioners for at least twenty years. Admissions under this section shall not exceed three annually.

Until the proposed alterations in the Articles of Association are approved by Fellows of the College, application must be made under the old system, except that a senior surgical qualification requirement will be enforced. The attention of all Fellows is directed to the fact that, after February, 1932, nominations shall be made only by Fellows of at least five years' standing.

### Primary Fellowship Examination in Australia.

The first primary examination in Australia for the diploma of Fellow of the Royal College of Surgeons of England was held at the University of Melbourne from August 11 to August 18, 1931. Twenty-four candidates entered for the examination, but four withdrew, so that twenty presented themselves, of whom ten passed. The Council feels that this percentage of successes not only reflects great credit upon medical education in Australia and New Zealand, but is also a happy augury for the success of future examinations. The Council has decided, therefore, to explore the possibility of repeating this examination in Australia at an early date, and also to hold a similar examination in New Zealand.

### Higher Degrees in Surgery.

At the last annual general meeting, held in Sydney in March, 1931, it was suggested that the College should request the Faculty of Medicine of the University of Sydney to omit the subject of general pathology from the first part of the M.S. examination of that University, in order to bring about uniformity with the Universities of Adelaide and Melbourne, in which the subjects of part one of the examination are anatomy and physiology only. It was also suggested, at this meeting, that the College should ask the University of Sydney to adopt a regulation, similar to that of the University of Melbourne, exempting candidates who have passed the primary examination for the fellowship of the Royal College of Surgeons of England from the examination for part one of the M.S. degree.

The Registrar of the University of Sydney has informed the Council that, in response to this request, the subject of general pathology has been omitted from part one of the M.S. examination, but that the Faculty of Medicine had refused to grant exemption from this examination to candidates who have passed the primary examination of the Royal College of Surgeons of England.

### Report of the Hydatid Registry.

Roland A. H. Fulton, Registrar of the Hydatid Registry, submits the following report:

Since my last report, only a small number of cases has been registered, the total to date being 85.

It is to be expected that the number of cases registered should show a decline during the holiday months, but no doubt cases have been accumulating, and it is to be hoped that a large number will be forwarded in the course of the next month. The success of the Registry depends almost entirely on the support given by the Fellows, since over 80% of the records have been supplied by them.

Progress reports on cases already registered are especially valuable, as also are records of cases which have been operated on many years ago, and which are now seen from time to time, enabling their present condition to be ascertained.

It has been suggested to me that the honorary secretaries of the honorary staffs of the main hospitals might be able to bring the matter before the members of the staffs, reminding them of the existence of the Registry, because there is no doubt that by far the largest number of hydatid cases met with are treated in the public hospitals, and this is a source which hitherto has not bulked largely in the records sent for registration.

### Candidates Elected as Fellows.

The following candidates have been elected as Fellows:

*Egypt.*—John Edwin Bateman.

*England.*—Joseph Cunning and Charles David Read.

*New South Wales.*—Walter Ramsay Beavis, Reginald Henshall Bettington, Eric Phillip Blashki, Reginald McDougall Bowman, George Arthur Buchanan, Reginald Eric Buckingham, Douglas Gordon Carruthers, John Nicholson Chesterman, Cedric Keith Cohen, Harry Carysfort Edmond Donovan, Archibald Roxburgh Hunt Duggan, Malcolm Sidney Stewart Earlam, Arthur Paul Gillespie, Norman McAlister Gregg, Frederic Charles Bruce Hittmann, Hamilton Speirs Kirkland, Louis Samuel Loewenthal, William Morton Craig MacDonald, John Stephen MacMahon, Vincent Joseph McPhee, Thomas Yeates Nelson, Robert James Nixon, Archelaus James Opie, Keith Shelley Parker, Alfred Charles Thomas, Mervyn Hetherington Thomas, Burron Gregory Wade, Henry Bruce Williams.

*New Zealand.*—William Gilles Borrie, Stanley Eric Vincent Brown, Alexander Gillies, Lancelot John Hunter, William David Stoney Johnston, Kenneth MacCormick, Alexander Smith Morton, Robert Stout, Hugh Lawrence Widdowson.

*Queensland.*—Ernest Culpin, Harold Vernon Foxton, John Hardie, George William Cardew Macartney, Edward John McGuinness, Charles August Thelander, Dallas Bradlaugh Walker, Frank Couper Wooster.

*South Australia.*—Thomas Alan Britten Jones, Charles Duguid, Harry Roy Pomroy, William Clifford Sangster, Alfred Ladyman Tostevin, Reginald John Verco, Esmond Frank West.

*Tasmania.*—Thomas Giblin, Berthold Hiller

*Victoria.*—Noel Edward Hamilton Box, Andrew Brenan, Donald Montague Brown, Norman Menzies Eadie, Cecil Alexander Gardiner, Eric Fitzgerald Harbison, William Ivon Hayes, Harold Rupert Hyett, Hugh Noel Murray Puckle, George Robin Adlington Syme, Thomas a'Beckett Travers.

*Western Australia.*—Adrian Ward Farmer, Edward Campbell Pope.

### Applications of Candidates for Junior Membership.

The following were admitted as Junior Members:

*New South Wales.*—Joseph Steigrad, Philip Neville Walker-Taylor.

### Conferring of Honorary M.D. Degree and Garden Party at the University.

On Thursday, February 18, The University of Melbourne held a special conferring in the Wilson Hall, at which a degree by special grace was conferred on C. H. Fagge, Esq., F.R.C.S. The Wilson Hall was filled with guests, among

whom were many visitors from other States and New Zealand and representatives of all the learned professions in Victoria.

The Chancellor of the University (Sir John MacFarland) said: "This is a meeting of the Council for the purpose of conferring a degree by special grace on the representative of the Royal College of Surgeons of England. This is the only articulate method of expression which the University has of conveying its respect for the great profession of medicine, for the Royal College of Surgeons of England, and for its representative who is with us on this occasion. It expresses not only our regard for the profession and for the College, but also our gratitude to the Royal College of Surgeons of England for the kindly and brotherly interest that it has taken in the foundation of the new College of Surgeons in Australia and New Zealand."

The Dean of the Faculty of Medicine (Professor W. A. Osborne), in an address, said that it was interesting to note that the distinguished body that was represented by Mr. Fagge had not yet celebrated its ninetieth birthday. It showed that a tradition as high even as that of the Royal College of Surgeons of England could be quickly established. Nothing could be more astonishing than the remarkable transformation that had taken place in surgery between the eighteenth and nineteenth centuries. He further remarked that the brilliant ceremony of the presentation of the great mace, which had taken place the previous night, and the present ceremony were calculated to strengthen the bonds of Empire. Professor Osborne also said that, at a time when the countries of the Empire were engaged almost exclusively with the economic bonds, it was very heartening to see the far more durable bond of sentiment being strengthened.

Mr. Fagge, wearing the hooded gown of scarlet, crimson and black of a doctor of medicine, was then presented by the President of the Professorial Board (Professor W. E. Agar) to Sir John MacFarland, who conferred upon him the degree of doctor of medicine.

In returning thanks, Mr. Fagge said that he rejoiced to observe the friendly, helpful attitude which the University of Melbourne, in common with other Universities in Australia and New Zealand, had adopted to the youthful Australasian College of Surgeons. It was to be hoped that the universities and colleges would march side by side towards the common goal of advancing scientific knowledge. "I thank you," Mr. Fagge concluded, "for the honour you have done to surgery, to my colleagues and to myself."

At the conclusion of the ceremony, the Council of the College entertained Fellows and their wives and distinguished guests at a garden party in the grounds of the University, where Mr. and Mrs. Fagge were introduced by the President to the guests. The mace was placed on exhibition in the quadrangle of the University and was the object of great interest and admiration.

### SCIENTIFIC MEETINGS AND HOSPITAL DEMONSTRATIONS.

Operative and clinical demonstrations, with short lantern lecturettes, were held at the Melbourne, Alfred and Saint Vincent's Hospitals.

Laboratory demonstrations were given in the Walter and Eliza Hall Institute at the Melbourne Hospital.

On Thursday evening papers were read and a discussion took place on acute abdominal emergencies.

On February 20 a meeting was held in the Anatomy School of the University, when short addresses on surgical subjects in the higher branches of surgery were delivered. Professor Wood Jones and his staff demonstrated anatomical preparations to illustrate some of the surgical addresses which had been given earlier in the morning. Professor Wood Jones also gave an address on medical history in relation to a Hunterian exhibition.

### DINNER TO MR. FAGGE.

On Thursday night Mr. Fagge was entertained at dinner by one hundred and fifty Fellows of the College. In responding to his toast, he drew attention to the happy relations between the two Colleges, and spoke of the ideals which should guide the Royal Australasian College of Surgeons.